AIRCRAFT PRODUCTION NUMBER—JULY, 1941

MACHINERY

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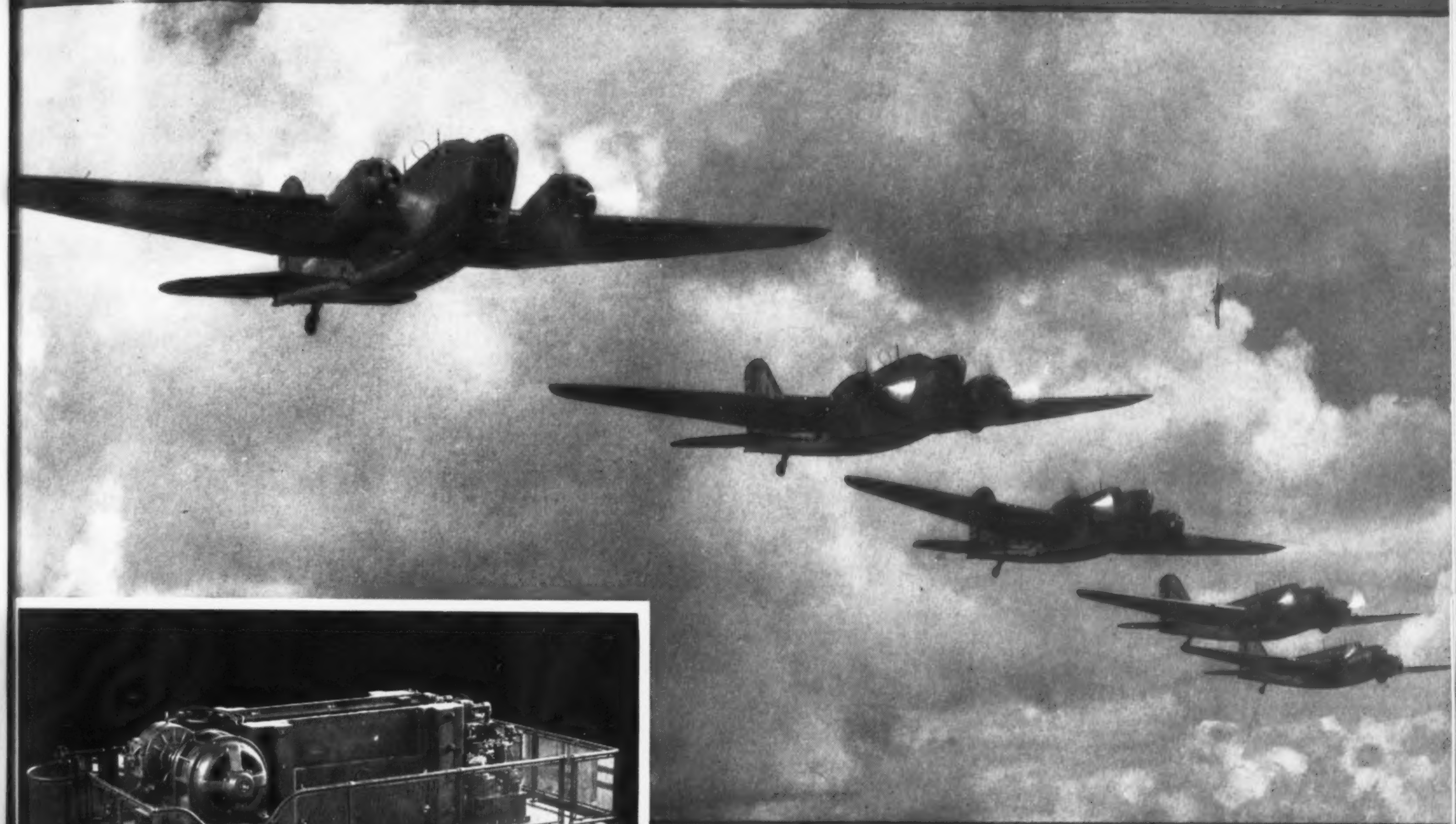
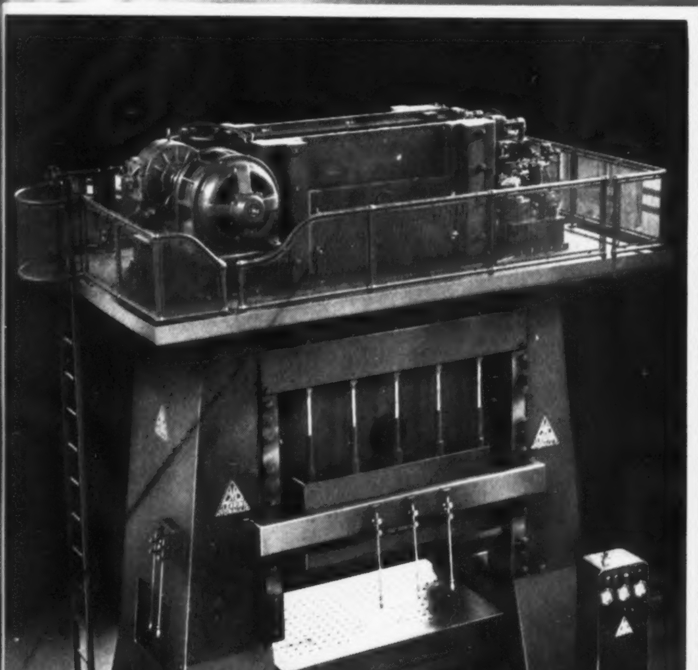
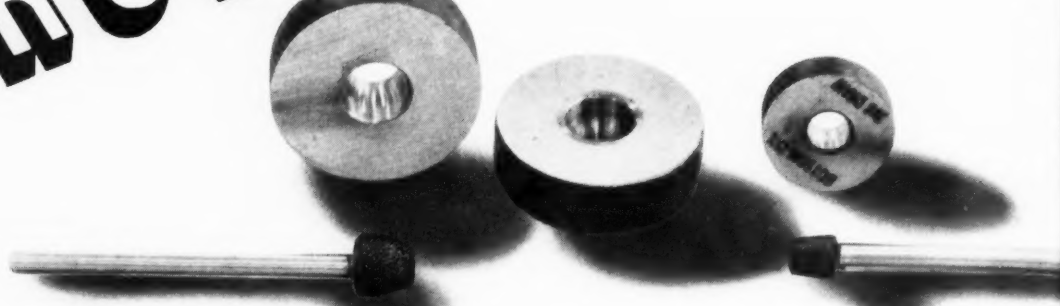




DOUBLE... TRIPLE... QUADRUPLE PRODUCTION



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Entirely automatic grinding of cartridge dies, except for loading and starting the machine, features operation of the Heald No. 81 *Plunge Cut* Internal. The dies are ground in a plunge cut with a form wheel and size is controlled automatically.

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If you're grinding cartridge dies for Defense Work you can't afford to neglect investigating the Heald No. 81 Automatic *Plunge Cut* Internal Grinder. Especially because this new Heald machine will grind contour die surfaces on an entirely automatic basis. In terms of cartridge die production this means that you can grind many more dies per hour than would be possible on a plain machine . . . it means that dies ground this way will be more uniform in accuracy, that less dies will be scrapped . . . and it means that highly experienced operators will not be required to obtain uniform, consistent results, 24 hours a day. Drop us a line and we'll be glad to tell you the whole story.

THE
HEALD
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Worcester, Massachusetts

MACHINERY

DESIGN, CONSTRUCTION, OPERATION OF METAL-WORKING AND ALLIED EQUIPMENT

JULY, 1941

PRINCIPAL CONTENTS OF THIS NUMBER

For Complete Classified Contents, See Page 262

In addition to an article on unusual methods in an outstanding aircraft plant, August MACHINERY will have several articles of broad general interest, including Spark Tests Applied to Identifying Different Grades of Steel; Balancing in an Automobile Factory; Characteristic Types of Dies; and Newly Developed Carbide-tipped Boring Tools. Also, a series of articles on munitions cleaning practice will start in the August number.

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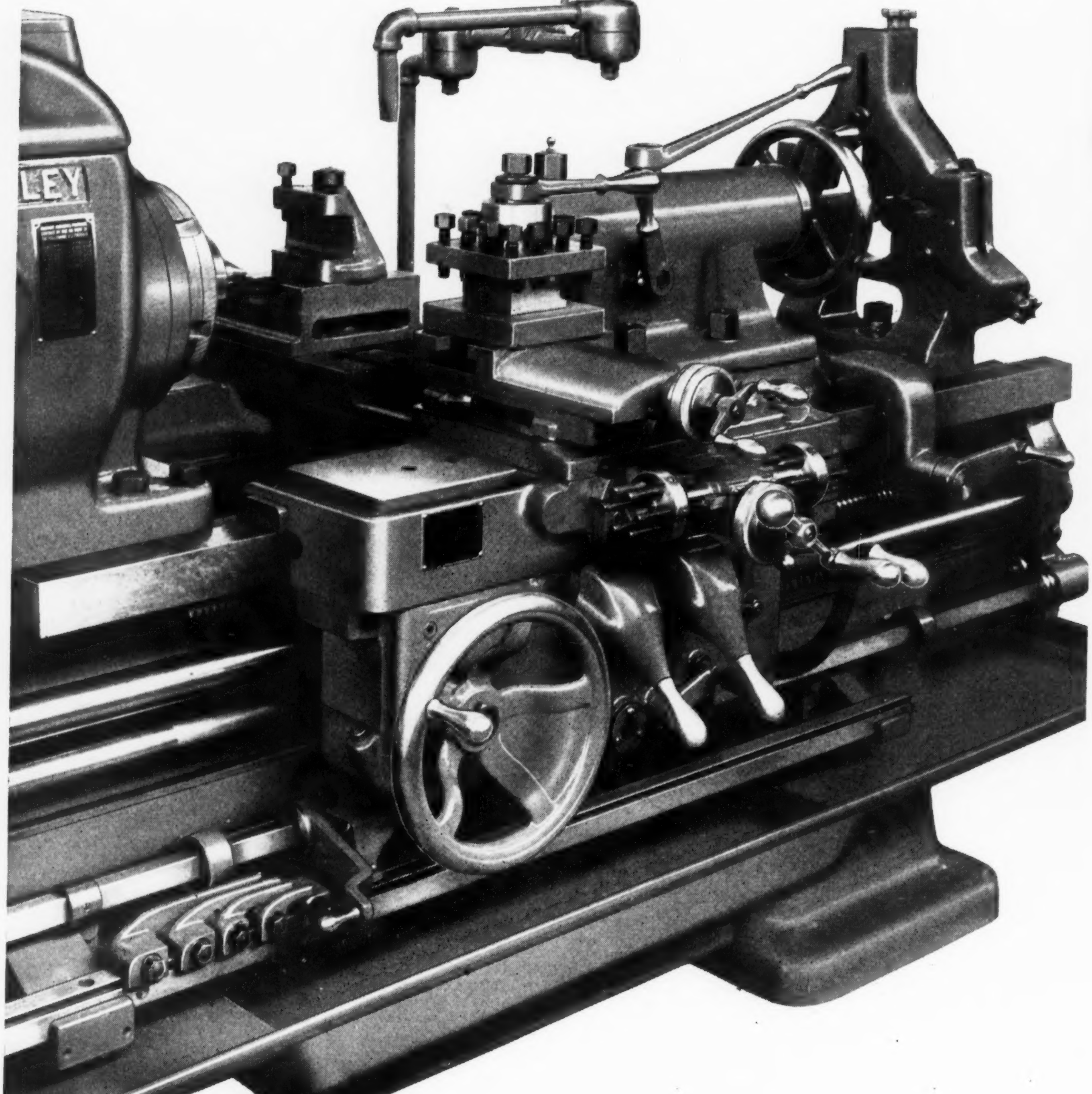
A Profit Building Lathe



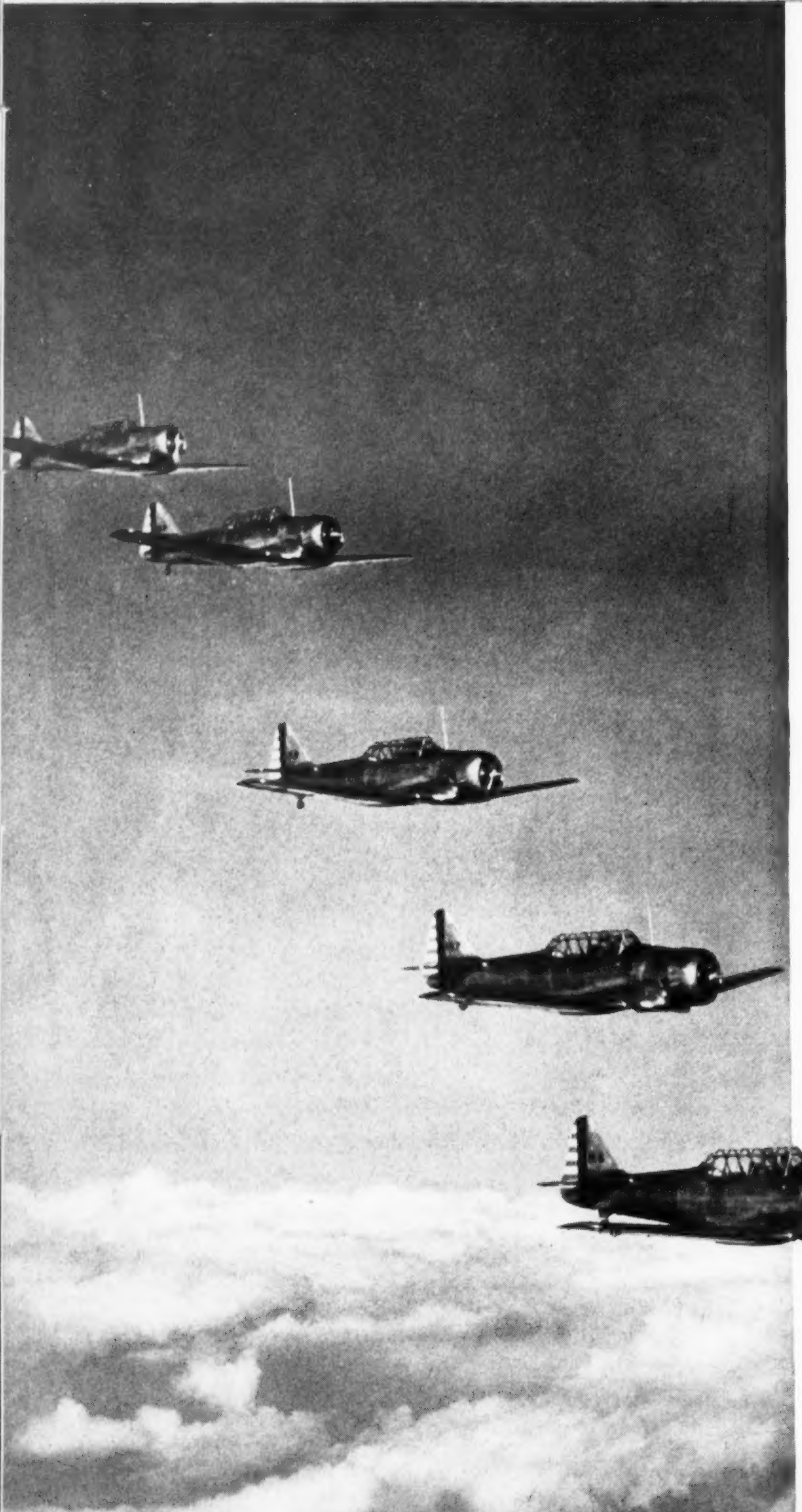
MACHINERY

Volume 47 NEW YORK, JULY, 1941 Number 11

THE AMERICAN AIRCRAFT INDUSTRY HAS BEEN GIVEN A TARGET TO SHOOT AT THAT CHALLENGES THE IMAGINATION. IT HAS BEEN CALLED UPON TO ACHIEVE IN A VERY SHORT TIME FAR MORE THAN NAZI PLANE-BUILDERS ACCOMPLISHED IN SEVEN YEARS. HOW OUR AIRCRAFT BUILDERS ARE HITTING THAT TARGET IS SHOWN IN THIS ISSUE, THE FOURTH ANNUAL AIRCRAFT PRODUCTION NUMBER OF MACHINERY.

NORTH AMERICAN'S Machine

By RALPH H. RUUD, Asst. Superintendent
North American Aviation, Inc.
Inglewood, Calif.

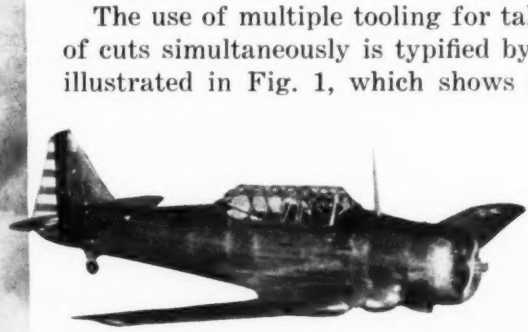


DURING its comparatively short period of existence, the Inglewood, Calif., factory of North American Aviation, Inc., has been expanded from its original floor space of 150,000 square feet in 1935 to its present area of 1,054,000 square feet. This plant is now completely devoted to the production of medium bombers, advanced combat trainers, and pursuit ships—both for the American and British air forces. It employs at the present time approximately 12,000 men. In addition to this plant, the concern has two factories rapidly nearing completion at Dallas, Tex., and Kansas City, Kans., each of which will be as large as the Inglewood factory.

The management of North American Aviation, Inc., has always believed that an ideal condition is attained when the machine shop of an airplane factory is large enough to handle all the machining work required on the plane parts, and from the very beginning as much of this work as possible was done in the factory's own machine shop. In order to continue on this principle, it was found necessary to triple the size of the machine shop during the last year and to expend over two million dollars in the purchase of new machine tools. All machine work, with the exception of some landing gear parts, is finished in this shop. Its personnel is 10 per cent of the number of factory employes.

The approximately 500 machine tools in this shop were selected and tooled up for quantity production to the extent that this is feasible in aircraft manufacture. Typical operations performed on these machines will be described in this article.

The use of multiple tooling for taking a number of cuts simultaneously is typified by the operation illustrated in Fig. 1, which shows a 12-inch Fay



Six Advanced Trainers on Their Way from North American's Factory to Army Air Corps Training Units

automatic lathe rough-turning the cylinders for the operating struts of hydraulic landing gear. These cylinders are made from chromium-molybdenum seamless steel tubing, 3 3/4 inches outside diameter and 3 inches inside diameter. Six tungsten-carbide tools are mounted on the front carriage, five of them taking turning cuts to the same diameter, and the sixth to a slightly larger thread diameter on the end that is held by the tailstock.

Two cutters are provided on the back arm, one of which cuts a fillet near the headstock end of the work when the back arm swings forward, while the second tool chamfers the tailstock end of the work at the same time.

Washers for absorbing engine-mount vibration are machined four at a time by the 3 3/4-inch Cleveland automatic illustrated in Fig. 2. The washers are produced from 2 1/8-inch diameter bars of 24 S.T. aluminum alloy. Two tools are mounted at the front of the cross-slide, one a form cutter and the other a cutting-off tool. There are two cutting-off tools at the rear of the cross-slide and another on an overhead slide that is in line with the center of the machine spindle.

In an operation, the stock is first fed forward against a stop on the tool turret, and then while the forming and cutting-off tools are in action, a 7/16-inch drill in the second station of the tool turret drills part way through the portion of the bar stock that is being machined into four washers. At the same time, facing cutters in the same station of the tool turret machine the front end of the bar to a slight angle. A drill in the third station completes the drilling of the 7/16-inch hole through the portion of the stock that is being machined. At the time that the photograph was taken, the tools on the front of the cross-slide had performed their function and the first drilling step had been completed.

A Footburt single-spindle screw machine tooled up for producing a fuel-tank stand-pipe assembly from brass bar stock is shown in Fig. 3. One of the finished pieces of work is seen at the left of the front cross-slide. In this operation, the stock is first fed forward to a stop on the tool turret. Then a box-tool in the second turret station turns the stock for a length of 3 3/8 inches and also centers, counterbores, faces, and chamfers the end of the stock. The photograph was taken immediately after the tools which take these multiple cuts had been indexed from the working position. The third turret station is equipped with a tool that drills a 7/8-inch hole to a depth of 2 1/4 inches. The fourth station is provided with another drill of the same diameter that cuts the hole to a depth of 3 3/4 inches.

While the drilling steps are in progress, a tool on the front cross-slide forms a surface near the left or head end of the piece ready for threading, after which another form tool on the rear cross-slide reduces the extreme left-hand end of the piece to a diameter of 1 3/16 inches for a width of 3/8 inch. Threads are next cut to a diameter of 1 1/4 inches, eighteen per inch, on the surface previously mentioned for a length of 5/8 inch. This is done by an H & G die-head in the fifth station of the tool turret. The part is finally cut off by a tool mounted above the work-spindle. All movements of the machine are actuated hydraulically.

Operating cylinders for hydraulic tail-wheel struts are machined from chromium-molybdenum steel tubing on the Warner & Swasey turret lathe shown in Fig. 5. One of the finished pieces is seen lying on the cross-slide. The tubing is turned the full length for the part being produced by a tool on the front of the cross-slide which is moved in and out by the operator as required to obtain four surfaces of three different diameters. During the

With Motors Running, Ten Scout Trainers Await Flyaway Delivery on North American's Huge Flight Ramp

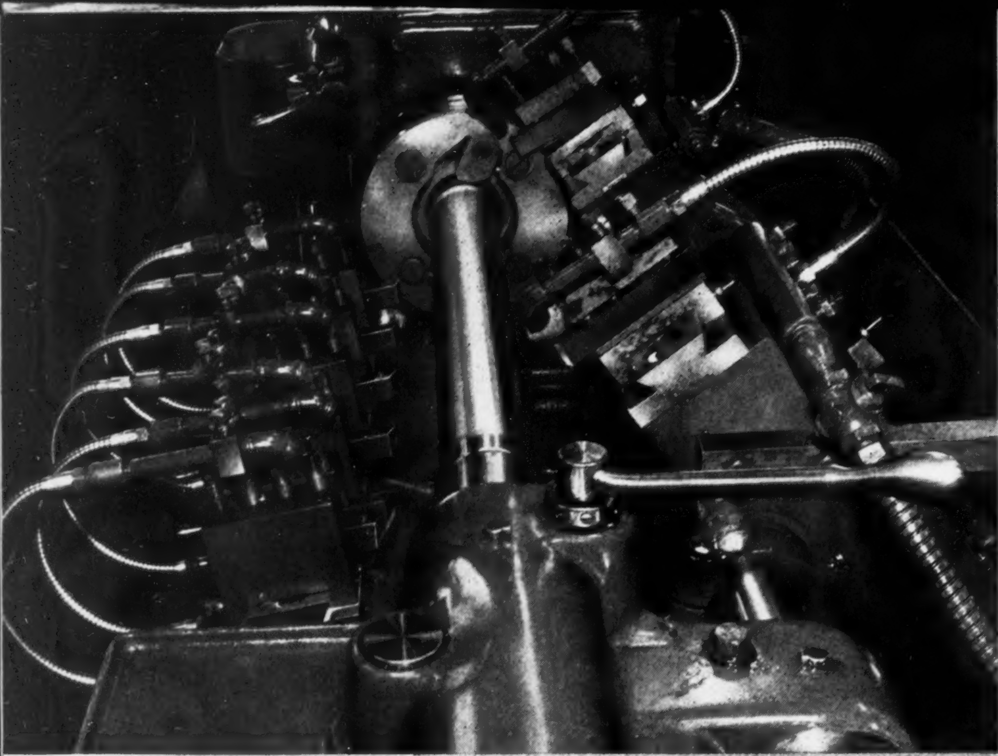


Fig. 1. Automatic Lathe Set up for Machining Operating Strut Cylinders for Hydraulic Landing Gear Typifies the Application of Multiple Tooling in an Airplane Factory Machine Shop

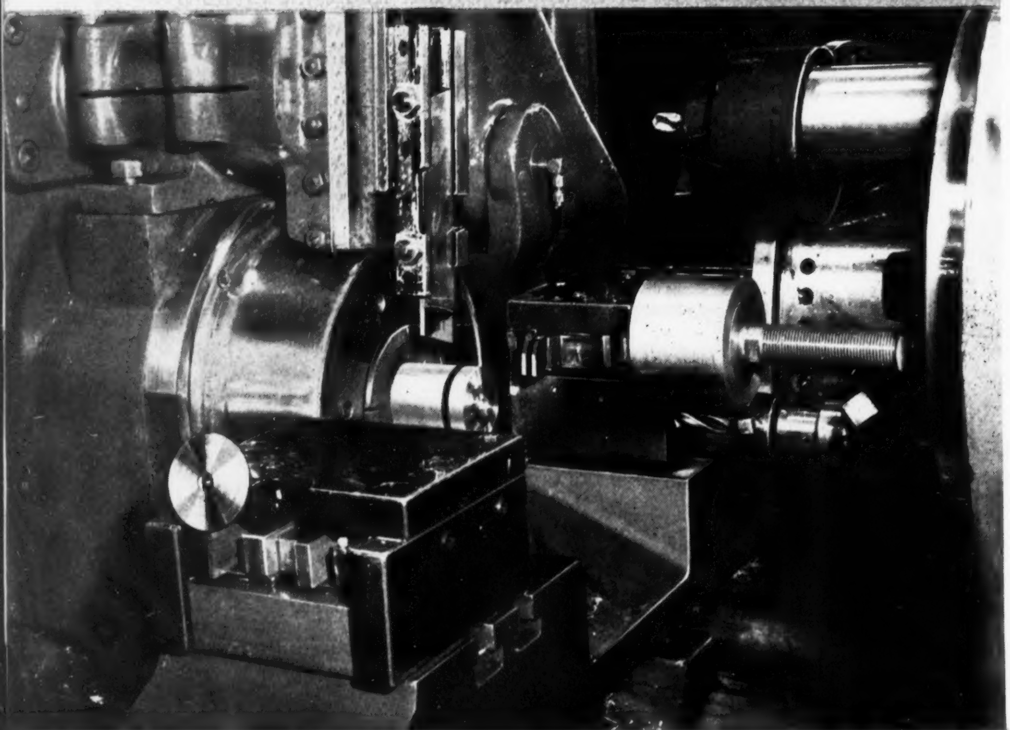


Fig. 2. Single-spindle Automatic Tooled up for Producing Four Washers from Aluminum Alloy Bar Stock at Each Machine Cycle

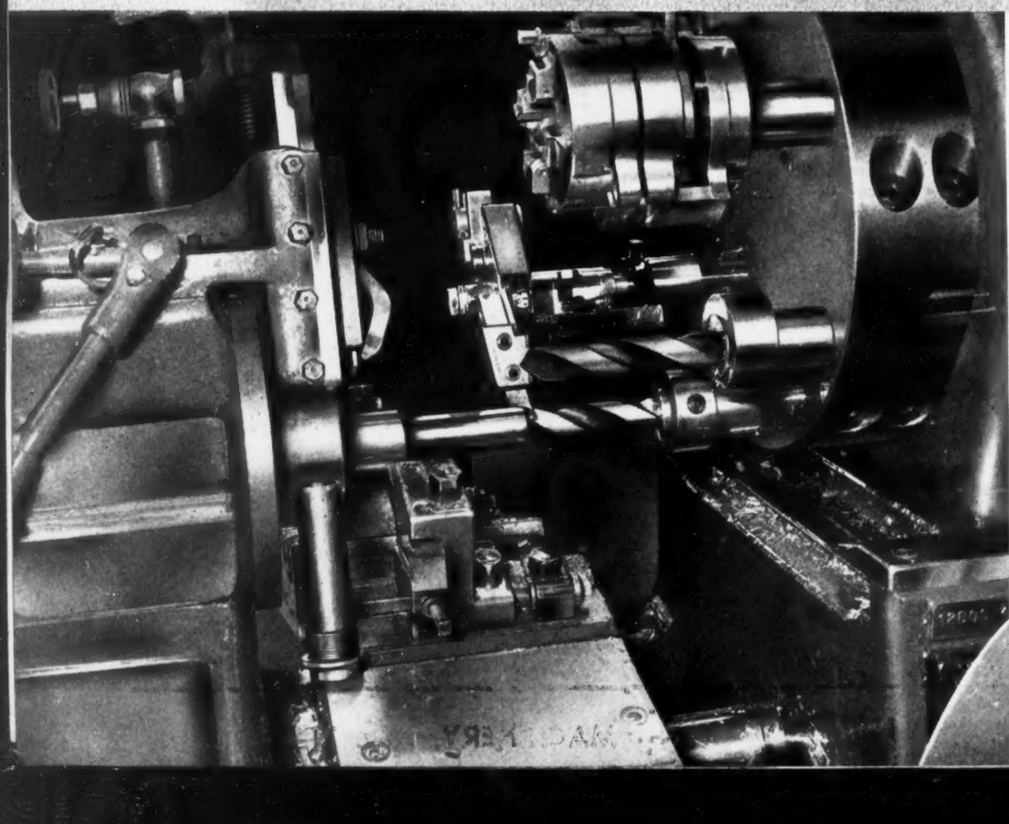


Fig. 3. Single-spindle Screw Machine which Produces Fuel-tank Standpipes from Brass Stock, Turned, Bored, and Threaded Ready for Use

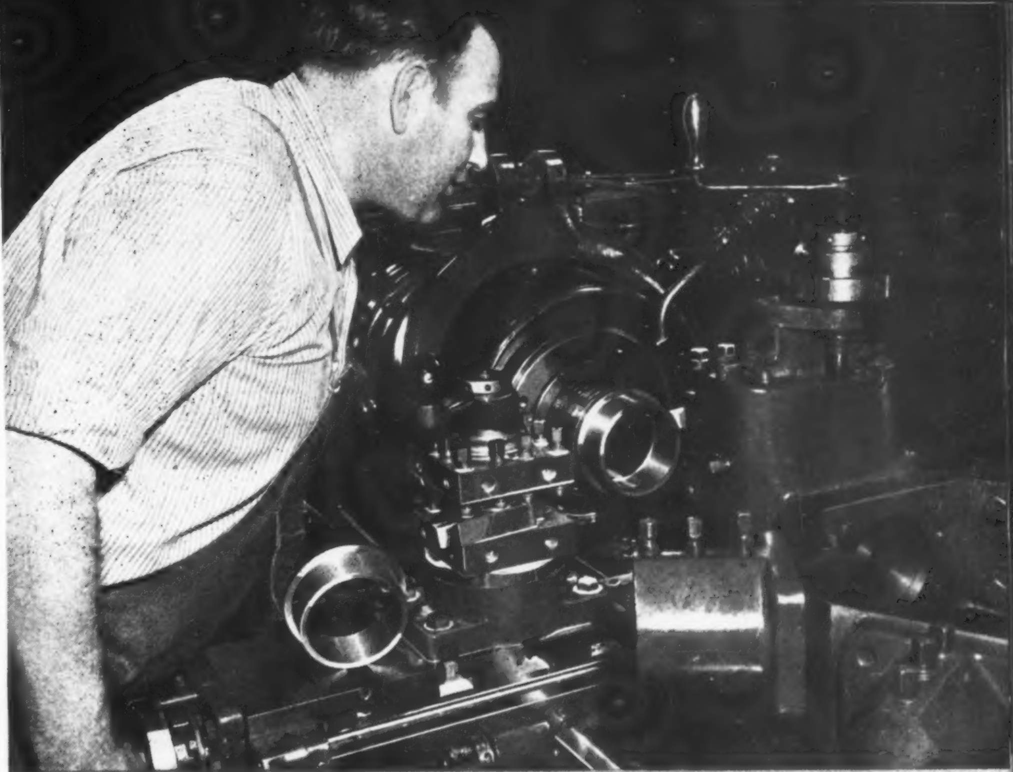


Fig. 4. Turret Lathe Operation in which a Tool Takes a Cut 3/8 Inch Deep on Chromium-molybdenum Steel at a Surface Speed of 238 Feet per Minute and a Feed of 0.015 Inch

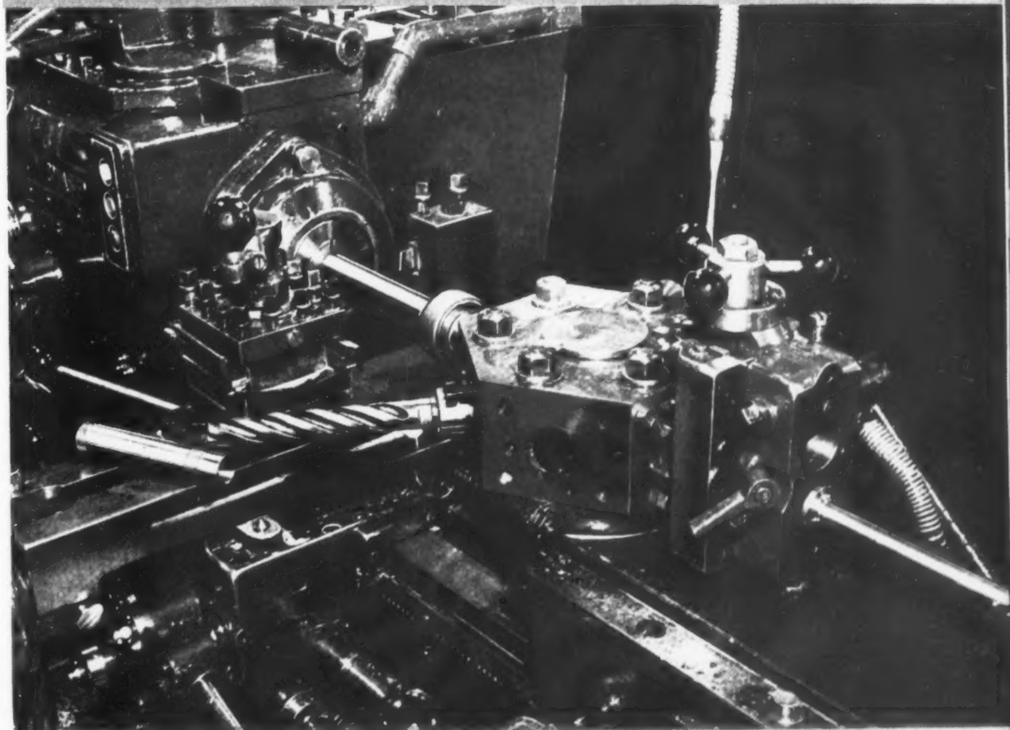


Fig. 5. Turret Lathe that Produces Hydraulic Cylinders from Chromium-molybdenum Steel Tubing, Turned, Drilled, Threaded, and Bored

Fig. 6. Cylindrical Grinding Operation on the Ends of Long Tubes which are Used as Equalizer Shafts for the Wing Flaps of Airplanes

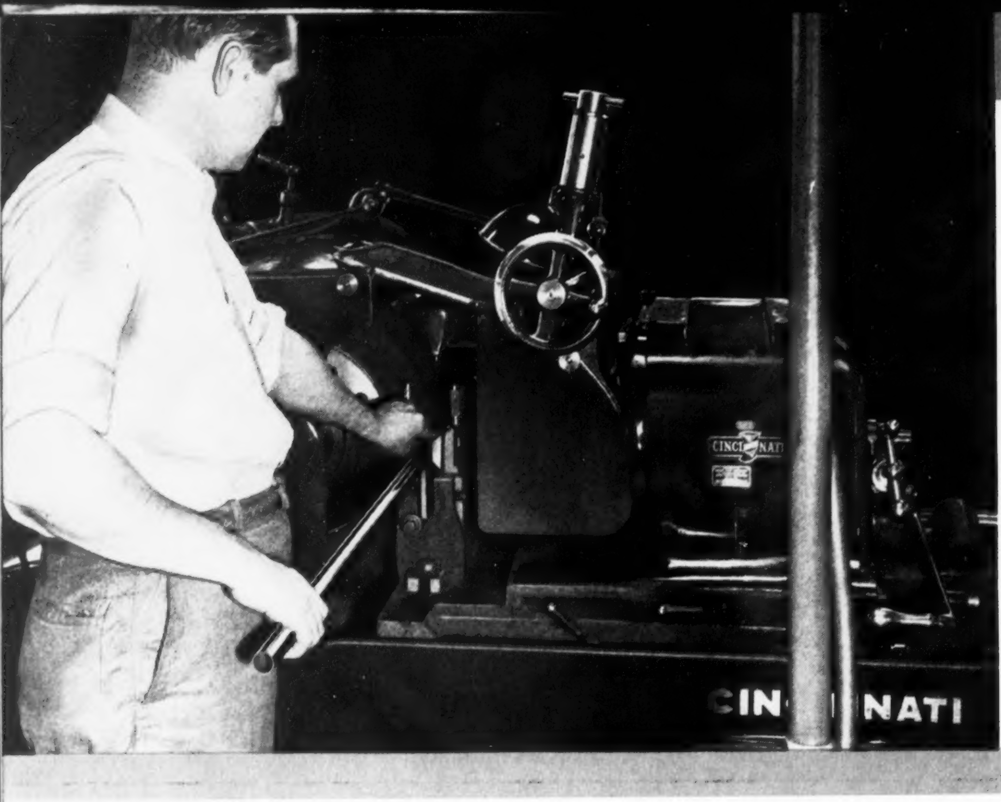


Fig. 7. Long Slender Tubes that have been Previously Cross-drilled are Finished Externally in a Centerless Grinding Machine as Here Illustrated

turning and while some of the following cuts are taken, the tube is supported on the overhanging end by a ball-bearing center on the hexagonal turret as shown.

When the turning cuts have been finished, threads are cut on the two large-diameter surfaces of the part by means of a chaser mounted on the toolpost at the front of the cross-slide. These threads are cut to a diameter of 1 1/4 inches, eighteen per inch, Class 3 fit. Upon the completion of the turning and threading, the tube is drilled out the full length necessary for one part by applying the long drill seen on the turret. Then the hole is bored to 1 inch, within limits of plus 0.002 inch minus nothing, by means of a single-point tool that is also mounted on the turret. The finished part is severed from the stock by means of the cutting-off tool at the back of the cross-slide.

Another turret lathe operation in which bushings are roughed out from chromium-molybdenum steel tubing, 5 inches outside diameter, is illustrated in Fig. 4. In this operation, which is performed on a Jones & Lamson turret lathe, the turning cut on the outside of the tubing is taken by a Rexalloy tool to a depth of 3/8 inch at a surface speed of 238 feet per minute and a feed of 0.015 inch. The tool is mounted at the front of the cross-slide.

When the turning cut has been completed, the part is bored by a tool on the turret, stock being removed to a depth of 3/32 inch. The part is then cut off with a tool at the rear of the cross-slide. Tubes 12 feet in length are handled on this machine. The parts are heat-treated after they leave the turret lathe and are later finish-machined.

The operation illustrated in Fig. 6 consists of grinding the ends of tubes which are used as wing-flap equalizer shafts. In this operation, which is performed on a Landis Type C plain grinder, the surfaces are ground to a diameter of 2.746 inches, within limits of plus 0.002 inch minus nothing, for a length of 2 1/2 inches. The tubes are 31 5/16

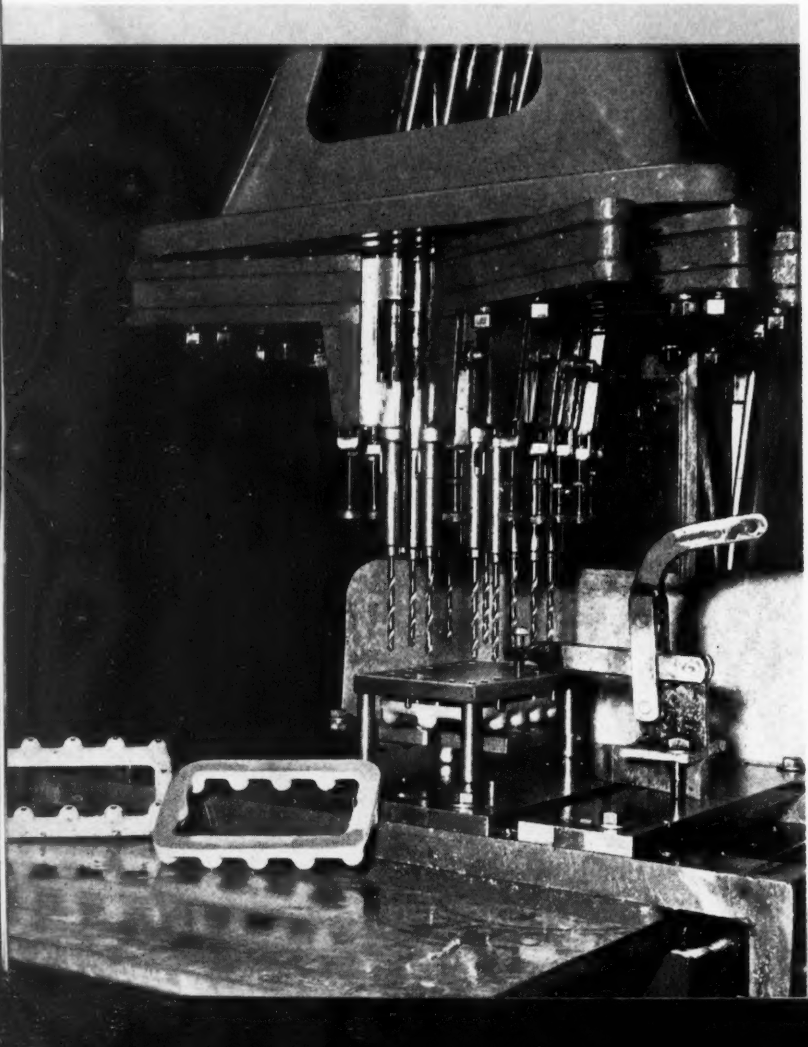


Fig. 8. Multiple-spindle Drilling Machine Equipped with Jigs for Quick and Accurate Drilling and Tapping of Holes in a Variety of Parts

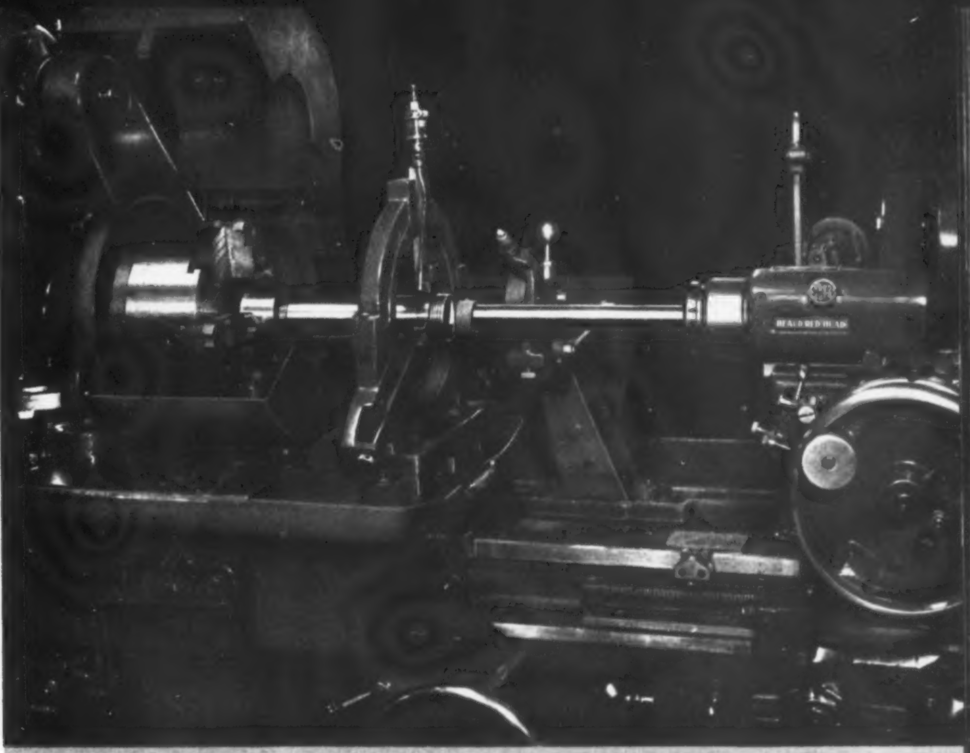


Fig. 9. Grinding the Bore of Hydraulic Retracting Cylinders for Bomb Doors which Must be Finished to Specified Diameter within Close Limits

inches long, and are provided with a plug at each end to permit their being held between centers on the grinding machine.

In Fig. 7 seat supporting tubes about 40 inches long are seen being ground the full length by a Cincinnati centerless grinding machine. This operation is performed after a series of twenty small holes has been drilled through the tubing. About four passes are made past the grinding wheel to obtain a diameter of 0.994 inch, within limits of plus or minus 0.001 inch.

Tremendous reductions have been made in the time of drilling and tapping operations by placing them on a multiple basis instead of drilling or tapping only one hole at a time, as was customary practice in the past. A typical operation of this kind is shown in Fig. 8 being performed on a Natco multiple-spindle drilling machine. Ten holes are drilled simultaneously in cast aluminum-alloy rings for fuel tanks. In this operation, No. 8 drills are fed to a depth of 5/8 inch.

The table of the drilling machine is fitted for the ready substitution of various jigs. Steel plates which may be adjusted along the table are provided with dowel-pins for locating the jigs accurately by means of holes drilled in the jig legs. Two diagonally opposite legs on each jig are located in this manner, thus insuring correct position of the jig in two directions.

A quick-acting clamp seen at the right holds the jig securely to the table. This clamp is provided with an adjustable screw to suit jigs of different heights. Two drilling operations and one tapping operation are performed on the part while it is held in the jig. The work is clamped in the jig by tightening thumb-nuts against steel blocks on the underneath side.

Hydraulic retracting cylinders for bomb doors are finished to the specified inside diameter within plus or minus 0.001 inch by the Heald internal grinding machine shown in Fig. 9. The machine can be set up for handling cylinders up to 5 inches

Fig. 10. Quick-acting Fixture for a Precision Boring Machine which can be Loaded on One Side while a Part on the Opposite Side is being Bored

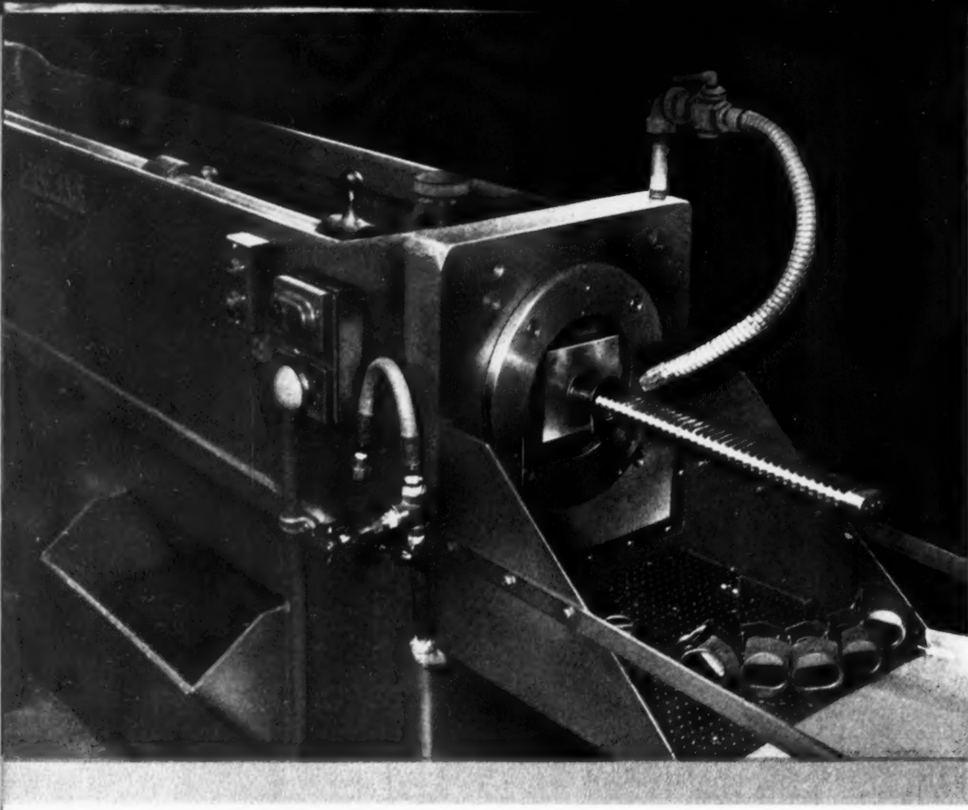


Fig. 11. Broaching Equipment Employed for Cleaning out the Elliptical Hole through Motor Mounts Formed by Welding Two Small Forgings together

in inside diameter by 30 inches in length. For the operation, the threaded end of the cylinder is screwed into a ring which is gripped in the chuck jaws, thus obviating any chance of marred threads as a result of the jaw pressure. After this operation, the cylinder is honed to a mirror finish in a Barnes Drill Co.'s honing machine.

Precision boring on a real production basis is performed by the Ex-Cell-O machine shown in Fig. 10, which is equipped with a fixture that can be loaded on one side while a part on the opposite side is being bored. The work-pieces are hinge type bearing supports in which the hole is held within a tolerance of 0.0005 inch, as required for the assembly of a ball bearing. The machine operates continuously, the fixture being fed first to one spindle head and then to the other. The handle at the front of the fixture operates both clamps, loosening one while tightening the other, thus greatly speeding up the operation.

Broaching has been adopted for finishing the elliptical hole in motor mounts of the type seen lying on the machine in the lower right-hand corner of Fig. 11. These parts are made up of two small forgings which are welded together around adjoining faces. In the broaching operation, which is performed on an Oilgear 50-ton pull type broaching machine, the 1 3/4- by 7/8-inch hole is "cleaned out," from 0.015 to 0.020 inch of stock being removed all around the hole. The broach is 2 feet long.

A typical high-production cam-operated drill jig is shown in Fig. 12 being used on a Cleereman drilling machine in conjunction with a special head on the machine spindle that carries two drills and a Govro-Nelson electrically driven automatic drilling unit, mounted on the same base as the jig. With this set-up, two holes are drilled vertically in the part, and a third hole horizontally, all at the same time. Twenty-eight of the parts handled by this jig are required on each airplane. When a sufficient number of parts have been drilled to meet

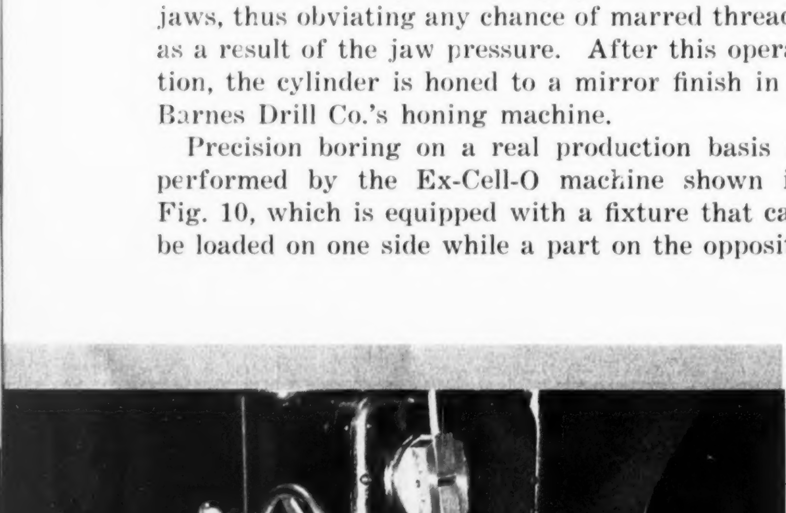


Fig. 12. Drilling Operation in which a Special Two-spindle Head Drills Two Holes Vertically while an Electric Unit Drills Another Hole Horizontally in Small Link Forgings

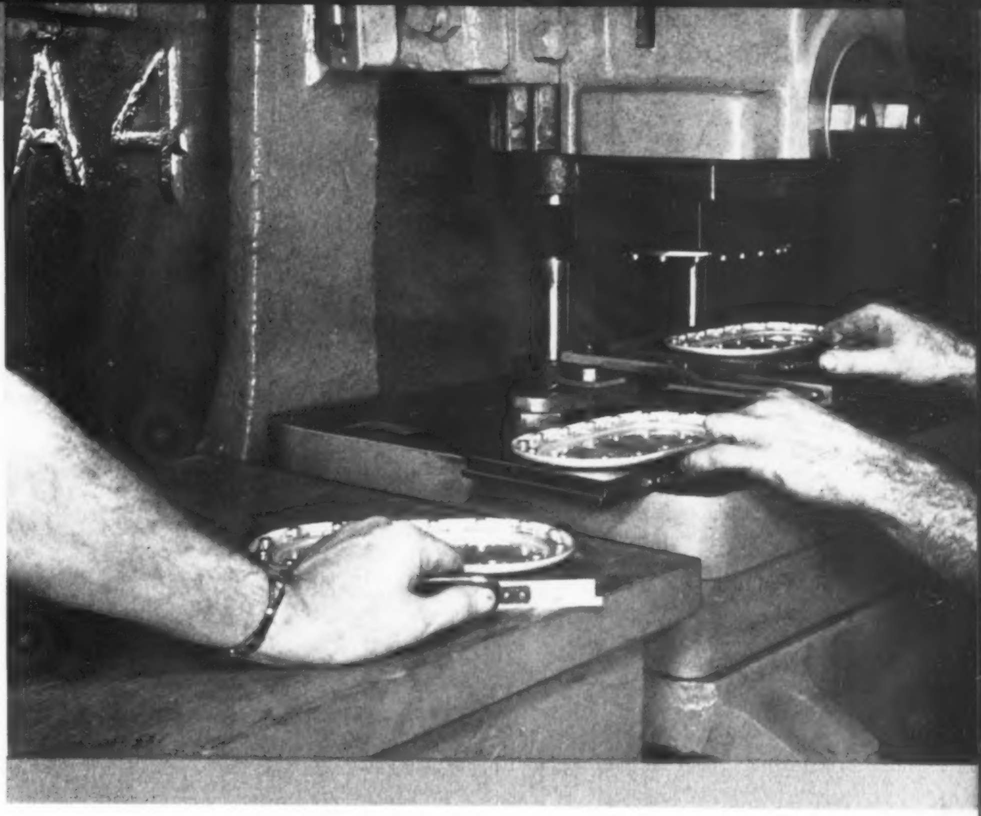


Fig. 13. Power Press Set-up for the Simultaneous Heading of Thirty-two Rivets; Auxiliary Die Plates are Reloaded while the Operation is in Progress

production schedules for a desired period of time, the Govro-Nelson automatic drilling unit can be conveniently transferred to other fixtures for similar applications.

The adaptation of a Niagara punch press to multiple riveting is illustrated in Fig. 13. Sixteen stop-nuts are attached simultaneously to a sheet-metal cover by the heading of thirty-two rivets when the ram of the press descends. A helper sets up each cover with its stop-nuts and their rivets on auxiliary die plates which are slipped into position on a holder beneath the ram by the press operator, and withdrawn upon the completion of the riveting. They are then passed back to the helper for reloading. All the rivet holes are punched in the cover at one time by the use of another die before the covers come to the riveting operation, and immediately after the punching operation the holes are press-countersunk on one end to receive the flush-head rivets by means of a third die.

Hand milling machines are applicable to machining a wide variety of small parts in an aircraft factory, and a considerable number of machines of this type are found in the machine shop being described. In Fig. 14, a Nichols hand milling machine is shown tooled up for milling a cam slot in small steel plates. The milling cutter is guided in the proper path to cut the slot to the desired outline by the engagement of a hardened pin with an identical slot in a templet that is mounted on the same fixture as the work. The guide pin is of the same diameter as the milling cutter. The machine table moves up and down as the fixture is fed to the right or left when the operator manipulates the handles on the front of the table and on the vertical slide.

Further examples of equipment used in the North American plant, including a considerable number of special machines designed by this company to meet the peculiar needs of the aircraft industry, will be described in an article to be published in a coming number of MACHINERY.

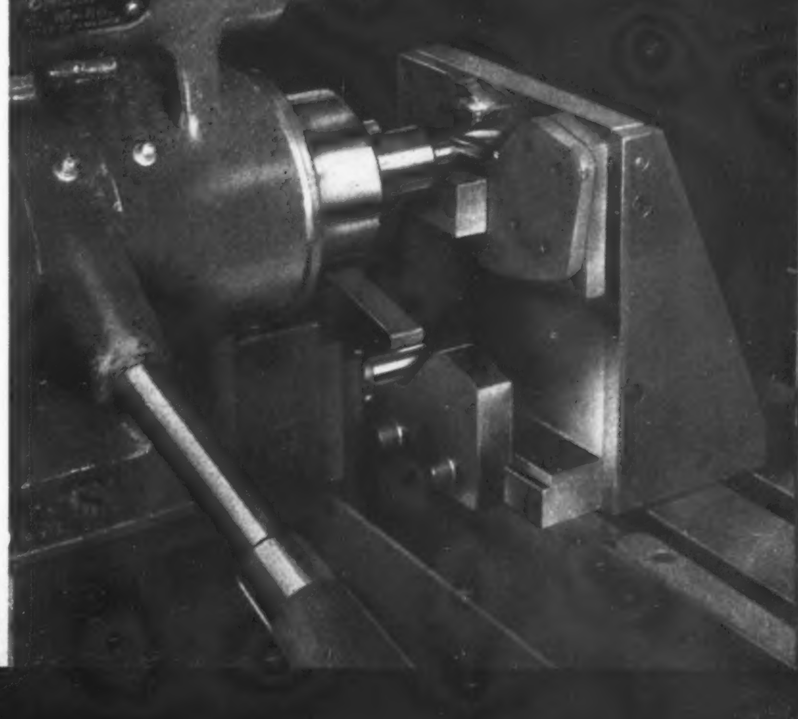
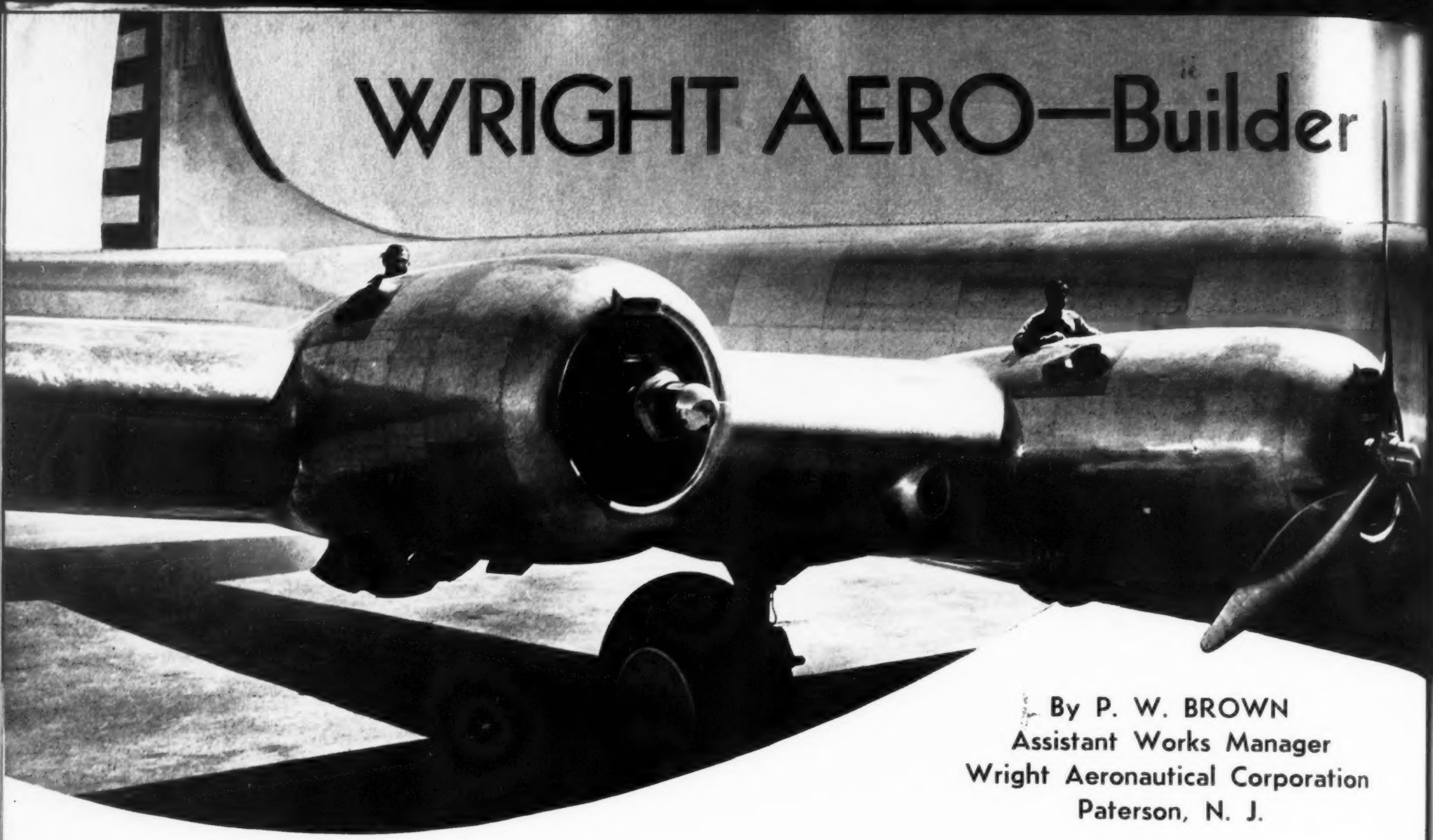


Fig. 14. Hand Milling Machine Applied to the Milling of Cam Slots in Steel Plates through the Provision of a Guide Roller and Templet for Controlling the Cutter Movements

WRIGHT AERO—Builder of



By P. W. BROWN
Assistant Works Manager
Wright Aeronautical Corporation
Paterson, N. J.

MANUFACTURING plants that have been identified with the aircraft industry for one or two decades are meeting the demands of the present emergency in a highly efficient manner. With their knowledge of the peculiar problems involved in the making of engines, planes, instruments, landing gear, etc., on the limited quantity bases of past years, the production men of these older established plants of the industry have been able to obtain large quantity production in a remarkably short period of time.

Most of these older concerns have had an expansion during the last year or two that borders on the phenomenal. Take the Wright Aeronautical Corporation, Paterson, N. J., as an example. This concern, in July, 1939, had a total manufacturing floor space of 900,000 square feet and a payroll of 5000 employes. Today (two years later), this concern operates four plants in Paterson with a total floor space of 2,856,000 square feet, and employs over 17,000 workers. In addition, the company is completing a plant near Cincinnati, Ohio, solely for aircraft engine manufacture, which is believed to be the largest single-story industrial plant in the world under one roof. The building housing the machine shop covers 33 acres alone, while the total area of the plant, including the aluminum foundry and the executive and engineering offices, is almost 50 acres.

Engineers are well aware of the fact that the intensive production methods of the automobile industry can seldom be applied in aircraft engine manufacture because, while present plans call for tens of thousands of airplanes annually, the number is small in comparison to the production of automobiles, which reaches four or five million a year. Nevertheless, present production requirements in the aircraft industry enable manufacturing methods to be used that are vastly different from those possible under smaller schedules.

The task of obtaining so great an amount of labor in so short a time seemed overwhelming. Every available skilled man within a radius of many miles was soon absorbed, and still the schedule was far from complete. To meet this shortage, a training system was started whereby completely unskilled labor could quickly be trained in the fundamentals of machine operation, and the skill that was formerly in the hands of the operators was built to a large extent into the machines themselves. More than any other single factor, this transfer of skill from man to machine has been responsible for the enormous increase in the ratio of horsepower to man power, for while the former has been increased 800 per cent, the latter has been increased only 340 per cent; in other words, each man is now producing nearly two and a half times as much engine horsepower per day as he produced two years ago, and that without any increase in the amount of physical labor involved. The installation of line production methods in both manufacture and assembly has, of course, also contributed greatly to this huge increase in output per man.

Some of the outstanding machining methods developed during the last year in the Paterson plants of the Wright Aeronautical Corporation will be described in this article, but it must be realized that many of these are in the nature of "pilot" installations for the purpose of investigating the possibilities of real mass production equipment to

# of World-Renowned Airplane Engines

be used in the Cincinnati plant, and of developing the experience necessary to operate such equipment.

The enormously increased schedules at the Paterson plant demanded, above all, speed, and much of the special mass production equipment required many months to design and build. For this reason, then, a considerable amount of semi high-production equipment, which was much less difficult to obtain, was installed, and from the experience gained in the use of this, much valuable knowledge was obtained to be applied in the design of fully automatic, high production equipment.

Reduction gears were machined on hand screw machines until the increased production requirements justified the installation of semi-automatic lathes, which resulted in a large reduction in machining time. Today's demands, however, are so great that these parts are now machined on Bullard Mult-Au-Matics, with a saving in time of nearly 90 per cent over the semi-automatic lathes. Four eight-spindle machine tools of this type have recently been applied to the roughing and finishing of reduction gears. All outside surfaces of the Nitralloy steel forgings are rough-turned and faced on one Mult-Au-Matic, and then rough-boring cuts are taken on all inside surfaces by a second machine. Other Mult-Au-Matics are employed for finishing the same surfaces. Two of the machines used on reduction gears are seen in Fig. 1. Other machines of the same type have been installed for machining bearing rings and cams.

In Fig. 2 is shown a twenty-one-spindle Natco machine designed for drilling, redrilling, and reaming seven holes in the legs of aluminum crankcase sections in one operation. On front and rear crankcase sections there are, of course, legs on one side only, but on center sections there are legs on both sides in which the holes must be machined. The holes are drilled to a diameter of 1/2 inch and are 2 1/4 inches deep.

Fig. 1. Mult-Au-Matics which have Greatly Speeded up Production in the Manufacture of Airplane-engine Reduction Gears

The machine on which this operation is performed is equipped with a jig that is moved from the loading position into the working position and vice versa, by the action of an air cylinder in the center of the sliding jig. When in the working position, as shown, the jig and the table on which it is slid back and forth, can be indexed into three positions in a horizontal plane to enable two drills of different diameters and a reamer to be applied to each leg of the crankcase section. Indexing is effected between three successive vertical movements of the spindles by manipulating a handle at the extreme right of the machine. The crank-handle seen a little farther to the left actuates sprockets and a silent chain, which lower the jig bushing plate after each crankcase section has been placed in the working position, and raise the bushing plate when the operation has been completed. The vertical movements of the spindle head are effected by hydraulic power. The time taken in drilling and reaming the holes in the crankcase sections is now only about one-fifth that required with the method previously used.

Another operation in which the time has been greatly reduced is the back-counterboring of the cylinder-sleeve hold-down screw-holes in crankcases. This operation is shown in Fig. 3. It is performed on a special Baush machine of vertical design equipped with a multiple-spindle head and a drum type of indexing fixture. Twenty holes are back-counterbored at one time around a cylinder pad, and there are fourteen cylinder pads on each crankcase. The operation is performed in one-eighth the time required with the method previously in use.

In this operation, the tools are fed through the previously drilled holes, and as they revolve, they move first about an eccentric path until they reach the desired diameter of the back counterbore, after which they revolve about a circle of that diameter to perform the operation. The tools then recede to the center of each hole to permit them to be withdrawn with the next upward movement of the spindle head.

Indexing of the work to bring successive cylinder pads into position beneath the head is accomplished by turning the crank-handle seen at the right. The jig is moved horizontally on the ways of the bed to

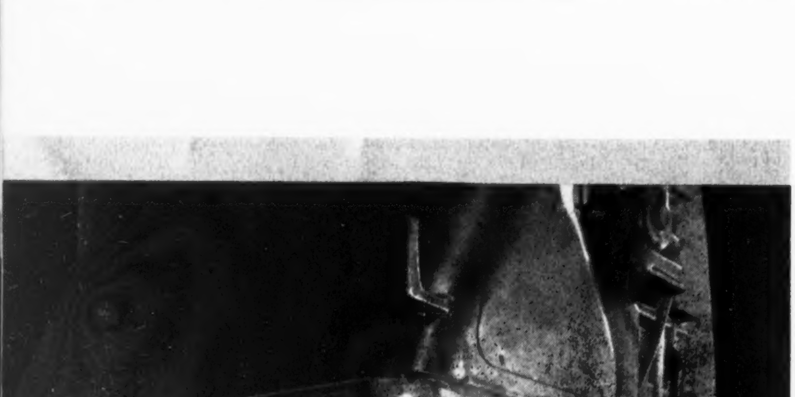


Fig. 2. Using Two Drills and One Reamer in Succession on Each Leg of Crankcase Sections, All Legs being Operated on Simultaneously

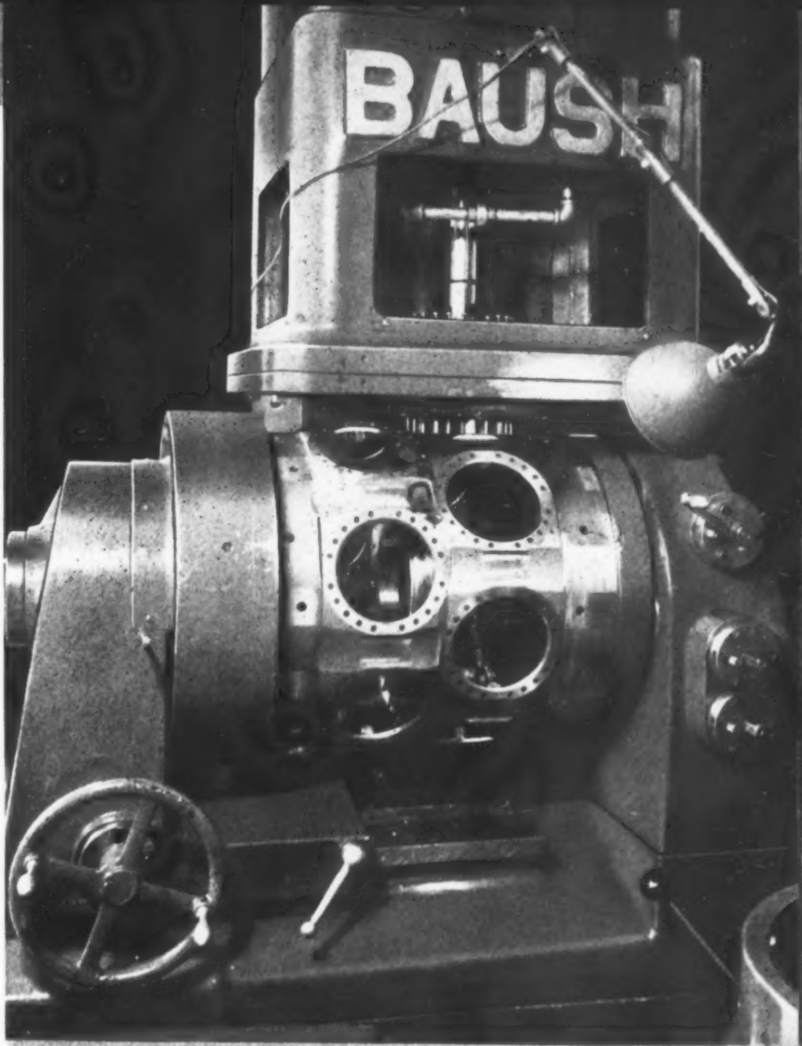


Fig. 3. Machine that Simultaneously Back-counterbores the Twenty Hold-down Screw-holes in Each Cylinder Pad on Crankcases

bring the second series of cylinder pads into line with the tool-head after the first series has been counterbored, and the jig is moved similarly to place it in the reloading position at the left-hand end of the bed. These horizontal movements of the jig are effected by applying a crank-handle to the square-end shafts seen projecting from the front of the fixture on the right-hand end. The large wheel seen at the lower left is manipulated to open up the fixture endwise for reloading.

In Fig. 4 is shown the largest surface grinding machine ever built by the Arter Grinding Machine Co. being applied to finishing the face and hub on the opposite ends of steel crankcases. The platform on which the operator stands is about 4 feet above the surface of the floor and the base of the machine. As the height between the two faces of the work is nominally 23 1/16 inches, the machine had to be constructed with an unusual amount of space between the magnetic chuck and the grinding wheel. The two faces of each crankcase must be ground the specified distance apart within 0.006 inch, but the height between either end face and the corresponding hub face is held to a tolerance of only 0.001 inch. The magnetic chuck is 32 inches in diameter.

The flats on hexagonal nuts are ground on the Gardner grinder shown in Fig. 5 at the rate of 500 an hour for 3/8-inch nuts, and at a somewhat slower rate for the larger sizes—a tremendous increase in production, as compared with the older method in which the nuts were held by hand, and each flat was ground, in turn, on the face of the wheel.

On this machine, the nuts are loaded, four at a time, on pins located between hard steel guides, different pins and guides being provided for the different sizes of nuts. Raising the handle seen in the center of the machine causes the nuts to pass between two grinding wheels, set the proper distance apart. As the handle is lowered, a spring-loaded finger engages a corner of the hexagon and rotates each nut, in turn, through 60 degrees, this rotation being made possible by the fact that one of the guides is hinged and is held in position by spring pressure. The nuts are thus ground on all six sides by three successive passes.

The lever seen at the extreme right-hand end of

Fig. 4. The Largest Arter Grinding Machine Ever Built being Used for Grinding Surfaces on the Ends of Assembled Airplane-engine Crankcases

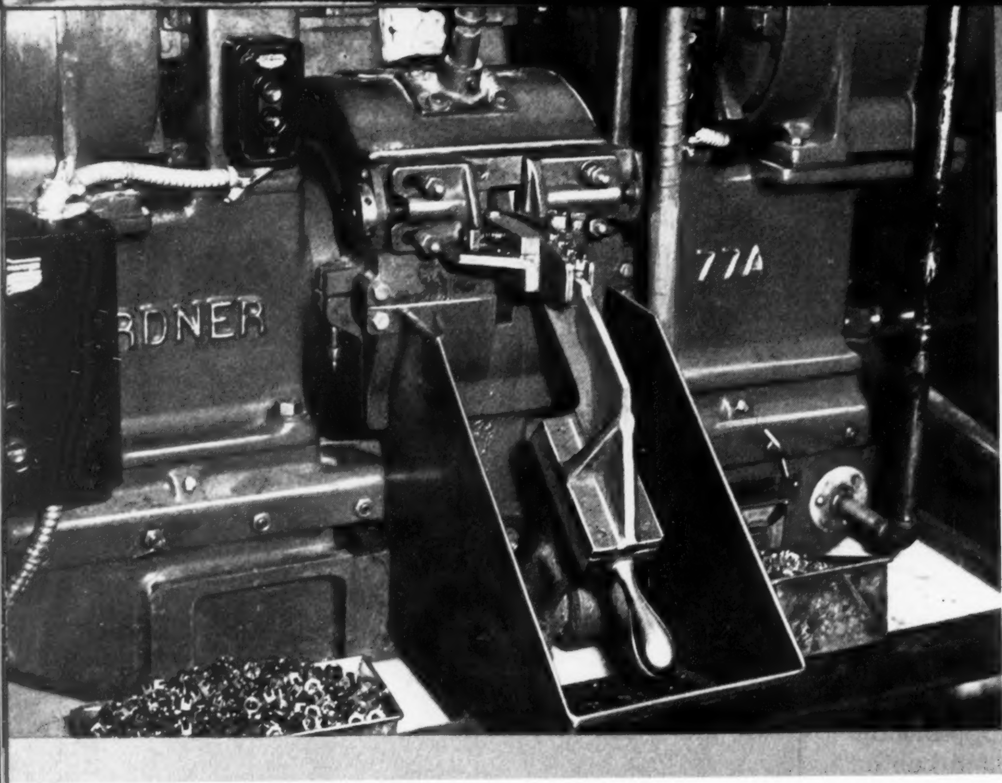


Fig. 5. Double-wheel Disk Grinding Machine which Grinds the Flats on Hexagon Nuts at Great Speed

the machine spreads both grinding heads simultaneously for adjustment and wheel-dressing, an individual fine adjustment being obtained through two graduated dials on the rear of the machine. The wheel-dressing attachment is located at the top and rear of the machine. A handwheel in the center controls the vertical movement of the diamonds across the face of the wheel by means of a rack and pinion, while the hand-knob on the right is used for horizontal adjustment.

The old-fashioned method of polishing aluminum pistons by hand on a buffing wheel has been replaced by the machine shown in Fig. 6, which is manufactured by the Udylite Corporation. This machine finish-buffs the sides, and the flat and bevel on the top in 15 seconds, as against 10 minutes with the hand operation, a reduction in time of approximately 97 1/2 per cent. Each of the six buffing wheels is driven by V-belts from its own motor, and is equipped with a pneumatically operated device which applies buffing compound automatically at each indexing of the table.

The pistons are located, two at a time, on chucks seen unloaded at the front of the machine, and the table indexes automatically. The chucks rotate during the buffing operation, but are stationary during indexing. Rotation also stops as the chucks come into the loading position. The table accommodates twelve pistons, but only six are actually buffed at one time. The guards that normally cover each wheel were removed when the photograph was taken, so that the wheels could be more clearly seen.

Quantity production is also exemplified by the operation shown in Fig. 7, which consists of grinding the ends of cylinder barrels, ten at a time. This operation is performed on a Hanchett surface grinder equipped with a special table fixture to which the barrels are clamped. The operation takes place after the barrels have been nitrided. From

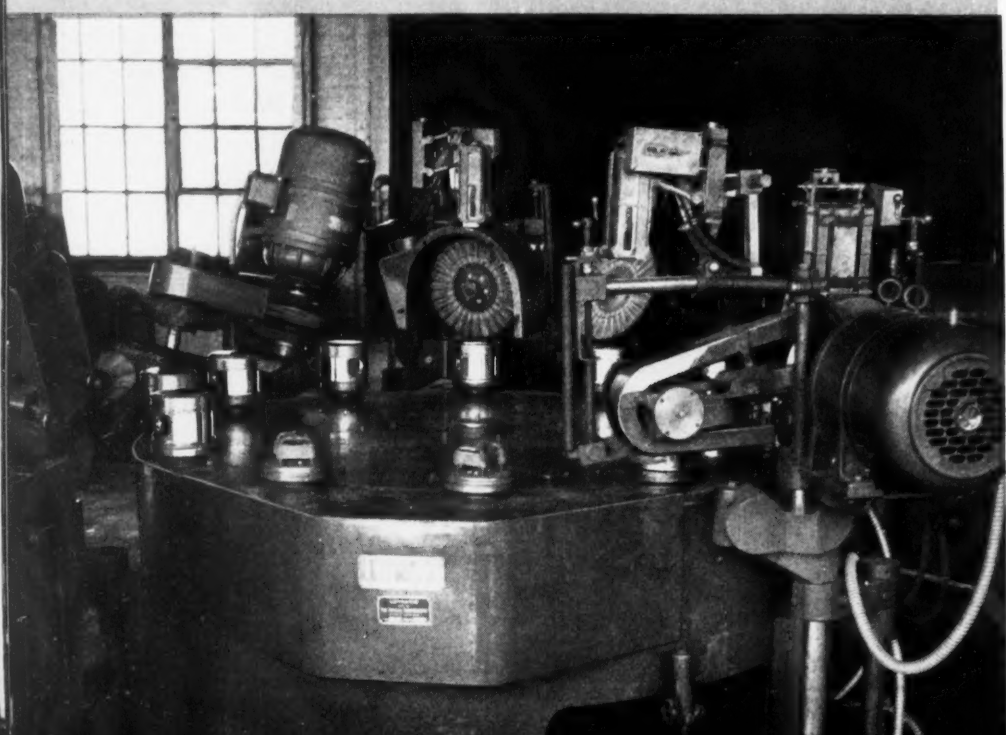
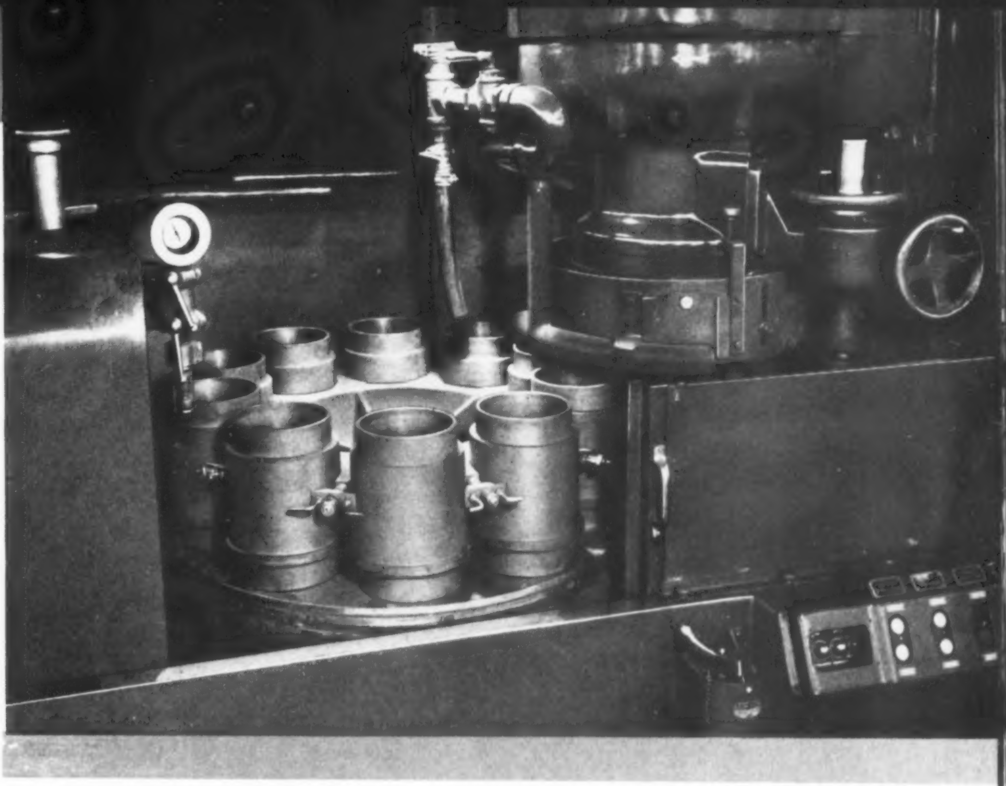


Fig. 6. Hand-buffing of Pistons has been Made Obsolete by an Automatic Buffing Machine which has Reduced Production Time 97 1/2 Per Cent

Fig. 7. The Ends of Cylinder Barrels are Ground, Ten at a Time, on This Surface Grinding Machine

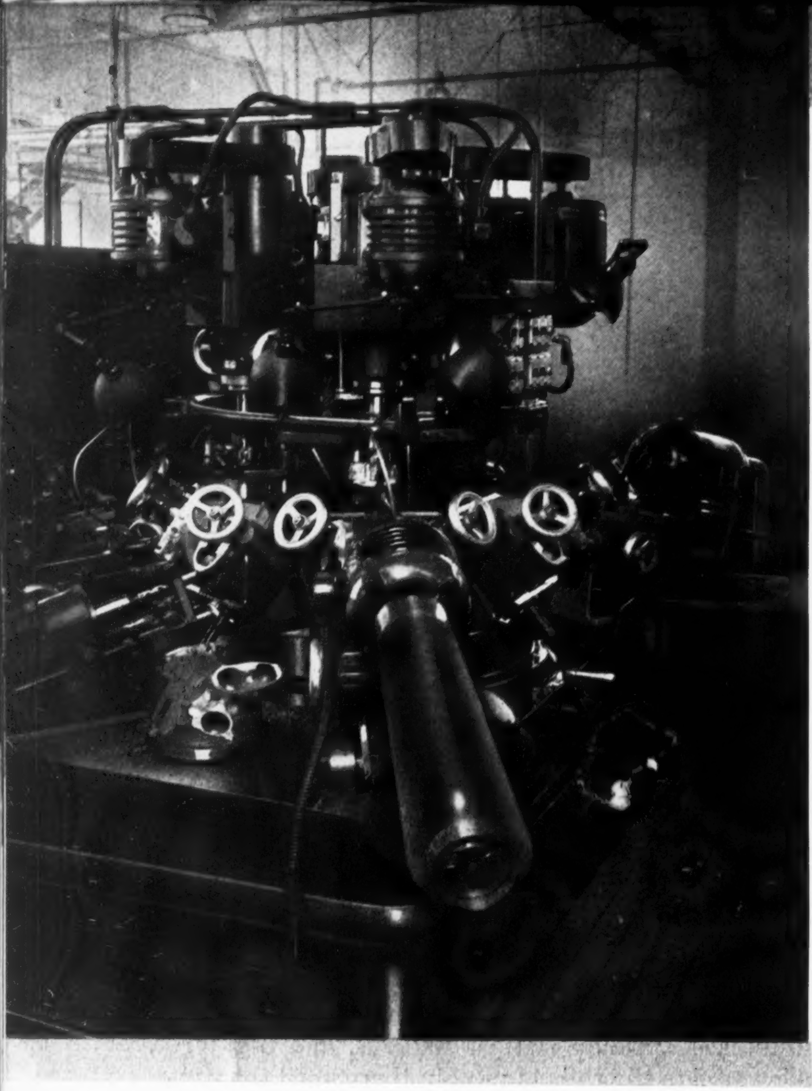


0.0015 to 0.020 inch of stock is ground off each barrel end to bring the barrels to the required length, as determined by means of a dial indicator mounted on the machine, which is seen at the left in the illustration.

The operation of finish-grinding the bore of complete cylinder assemblies just prior to the final honing operation is now being performed on the Heald internal centerless grinder shown in Fig. 8. For loading, the section of the runway that acts as a bridge between the machine proper and the centering device seen at the left-hand side is raised on hinges, and the cylinder assembly is then inserted in an aluminum drum equipped with hardened and ground steel rims. A hydraulic mechanism next swings the fixture vertically through 90 degrees and raises it to the level of the runway along which it is rolled to the centering device. Then two pairs of hardened rollers, actuated by a separate electric motor, raise the fixture from the rails and cause it to rotate slowly for inspecting by means of an indicator with a long extension arm. This device, which is visible at the left-hand side of the illustration, is slid into the barrel to check it for concentricity, which must be held to within 0.001 inch. The power used to revolve the work in this preliminary inspection is then shut off, and the part is lowered to the rails to remain there until the part in process is completed.

When that part has been ground, the front of the machine is opened, and the fixture holding the part is rolled out on the bridge, which then swings down to carry the finished part to the unloading position. At the same time, the bridge gap is closed by means of the hinged rails, so that the new part can roll across the bridge and into the machine, where it is engaged by the set of driving rollers. The front of the machine is now closed, and grinding begins, the size of the hole being constantly checked by a dial indicator attached to the machine

Fig. 8. Finish-grinding Cylinder Bores on an Internal Centerless Grinder Equipped with Ingenious Loading and Inspecting Mechanisms



and connected to an arm equipped with a diamond point. As the bore approaches the final size, it is checked with a special gage between each few passes of the grinding wheel.

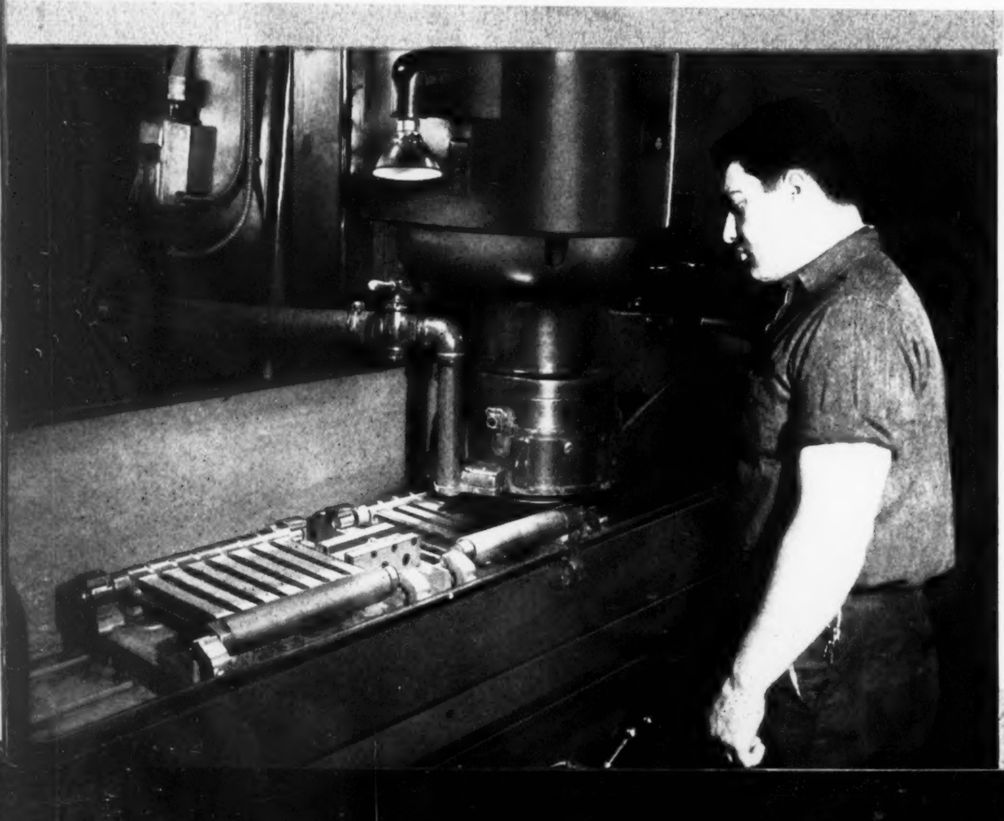
Machining the two spark-plug holes in the aluminum cylinder heads is accomplished in about 20 per cent of the time previously necessary by the use of the multiple-head machine illustrated in Fig. 9, which was built by the Barnes Drill Co. There are six working stations around this machine, one of which is used for loading purposes. In each of the remaining stations there are two tool-heads, one of which is positioned vertically, and the other in an angular plane extending toward the outside of the machine. The cylinder heads are loaded into fixtures mounted on a circular table which is indexed around the machine column to carry the work to each pair of tool-heads.

Identical operations are performed by both tool-heads of a pair on opposite spark-plug holes. The operations in sequence consist of spot-facing, drilling, reaming, countersinking, and tapping. The tool-heads are actuated hydraulically to and from the work, while the indexing is accomplished automatically by mechanical means.

Two quantity production operations on articulated connecting-rods are illustrated in Figs. 10 and 11. The first of these consists of grinding the arms of the rods on both sides after they have been broached. The operation is performed on a Hanchett surface grinder of the reciprocating table type, as shown in Fig. 10. The rods are loaded in batches of seven on arbors which are slipped through the wrist- and knuckle-pin bearing holes. Two batches of seven rods are loaded on the machine at a time for grinding one side of all rods. The rods are then reversed in the fixture without removing them from the arbors for grinding the other side. The arbors are provided with ground ends to insure accurate location in the fixture. The

Fig. 9. Multiple-head Machine that Simultaneously Performs Various Operations on the Two Spark-plug Holes in Aluminum Cylinder Heads at a Great Saving in Time

Fig. 10. Grinding the Sides of Articulated Rod Arms, with the Rods Mounted in Batches of Seven on Two Arbors



width across the ground arm surface is held within a tolerance of 0.003 inch.

With the articulated rods still mounted on the arbors, they are passed to the Mattison grinding machine shown in Fig. 11 for grinding one end to the required contour. This machine is equipped with a fixture that swings the rods back and forth beneath the grinding wheel while they are reciprocated to the right and left with the table. The wheel face is dressed to the radius of the rod ends. The swinging motion of the fixture is obtained through a separate motor drive and speed reducer seen at the right, which operates a crank and link motion that is connected to the fixture. A diamond dresser at the left-hand end of the table maintains the correct wheel form. When the operation has been completed on one end of the rods, the opposite ends are ground on another machine of the same type, with the rods still being held on the same arbors.

A specially designed Van Norman milling machine equipped with two cutter-heads has been installed for simultaneously finishing the intake and exhaust lobes of cam-rings. This operation, which is illustrated in Fig. 13, is performed after the parts have been copper-plated, and prepares the cam surfaces for carburizing and casehardening. The tool-heads are moved in and out, on the right- and left-hand sides, to mill the desired contour of the cam lobes by means of master cams on the work-spindle, against which rollers on the tool-spindles are held in engagement through the use of air cylinders. The work-piece is clamped securely by means of an air-operated draw-bar. Correct radial location of the cam-rings on the work-head is insured by a finger that engages two internal teeth on the opposite side of the cams from that seen in the illustration. After hardening, the cam lobes are ground on Landis cam grinding machines.

Fig. 11. The Bosses on the Ends of Articulated Rods are Ground to the Required Contour by Using a Form Grinding Wheel and an Oscillating Fixture

Fig. 12. Double-head Milling Machine Used for Simultaneously Milling the Intake and Exhaust Lobes of Cam-rings

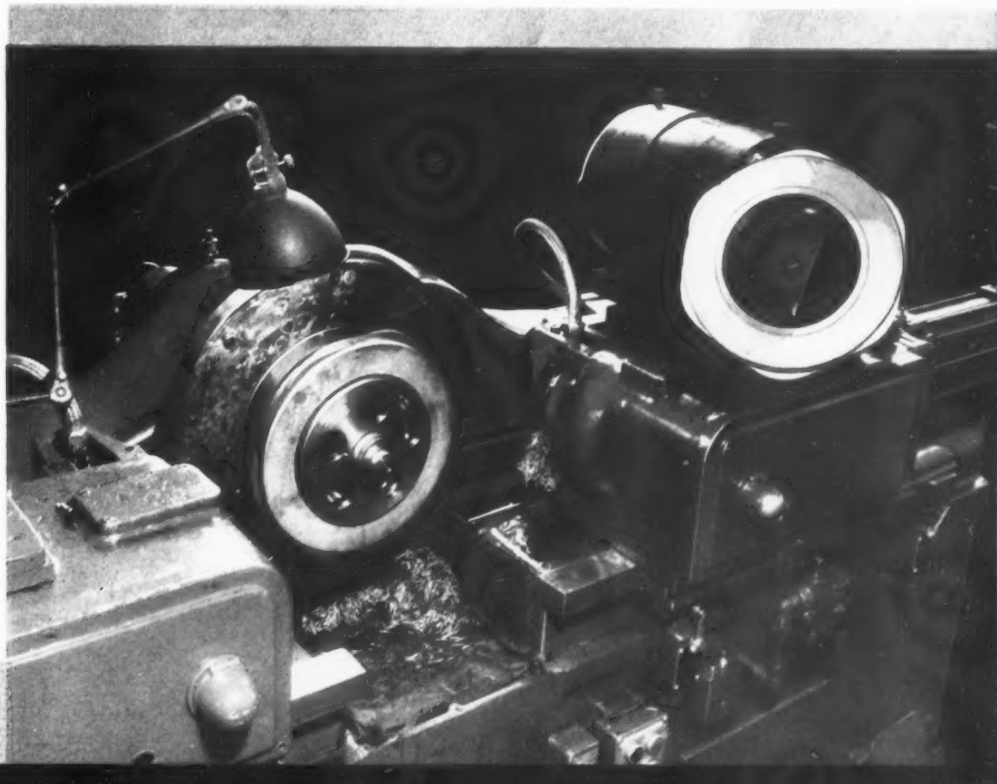


Fig. 13. Interchangeable Heads are Used for Drilling, Countersinking, and Tapping Intake and Exhaust Port Flanges on Various Types of Cylinder Heads

The operation of drilling, countersinking, and tapping the 3/8-inch holes with 16 threads per inch in the flanges of the intake and exhaust ports of cylinder heads was formerly performed on a single-spindle drilling machine, but today's production demands have led to the adoption of the special Barnes drilling machine shown in Fig. 13. The parts are loaded at the top of the work fixture, which rotates in a vertical plane, being located by pins that engage in the reamed valve-guide holes. They are secured by swinging clamps which bear on the top of the rocker boxes. The table indexes automatically, one piece being finished at each quarter revolution.

To insure accurate alignment, the drilling head is equipped with a bushing plate that carries two hardened dowels which engage bushings at the base of each fixture. On the particular cylinder head shown only the exhaust port requires this operation, but on certain other heads, the intake port also must be drilled, countersunk, and tapped. There may be either three or four holes to be machined. To accommodate the various types of cylinder heads, separate drill heads are provided, which may be quickly exchanged for those on the machine. Carefully aligned dowels permit accurate set-ups with a minimum of adjustment. The speed of production is dependent upon the speed of the operator in loading and unloading the machine.

A Footburt vertical type of machine equipped with two multiple-spindle heads for drilling operations on the reduction-gear carrier-rings, is illustrated in Fig. 15. The head at the left drills twenty holes, 9/32 inch in diameter, through the trunnions from the back of the part. The head at the right is then employed to drill twelve holes, somewhat larger in diameter, through a flange on the inside of the piece. In operation, the jig plate is lowered

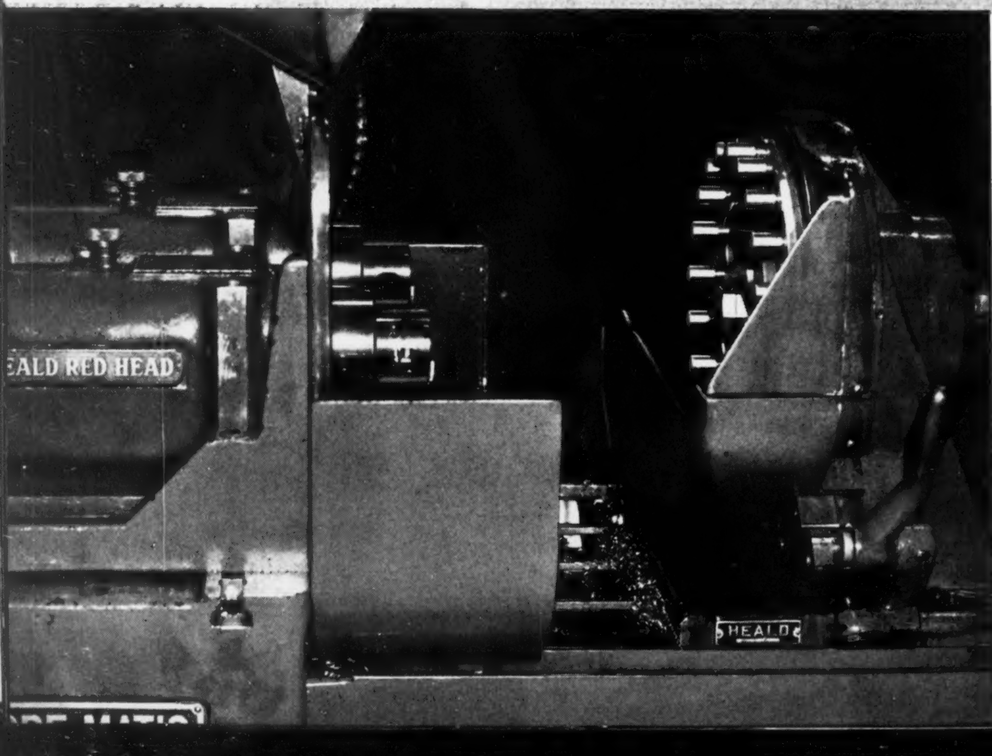


Fig. 14. Carrier-ring Trunnions are Machined Two at a Time with Carbide-tipped Tools in This Bore-Matic

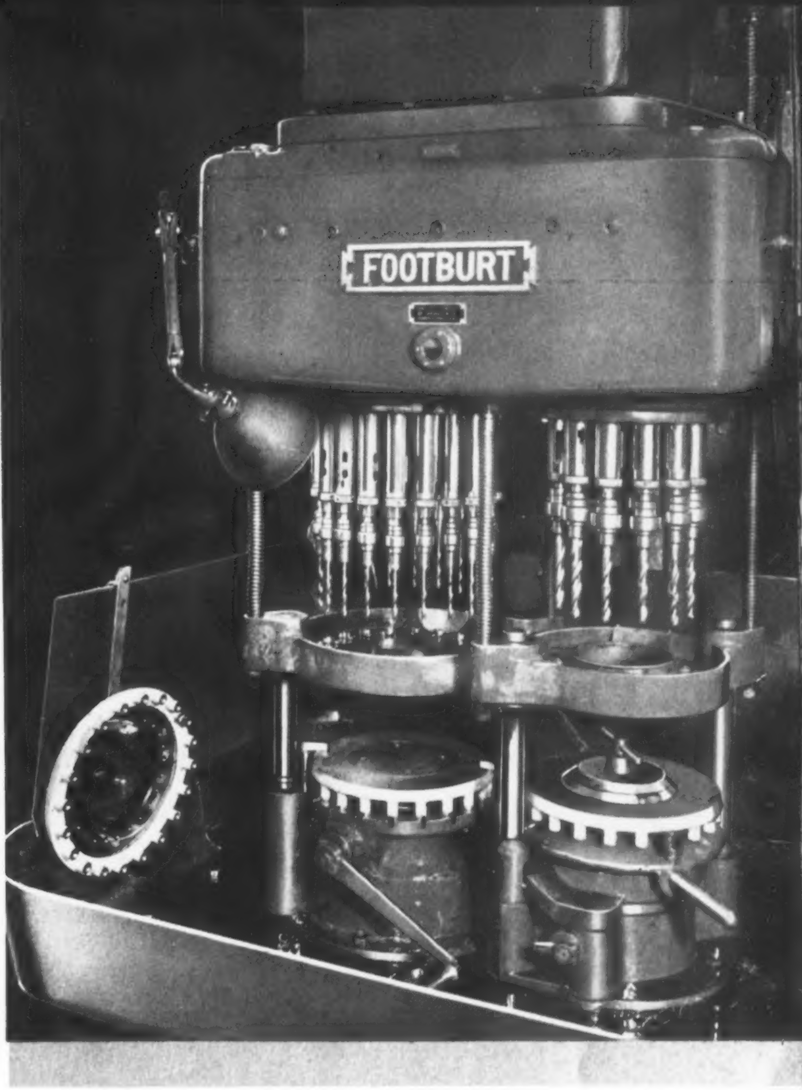


Fig. 15. Vertical Drilling Machine Equipped with Two Multiple-spindle Heads for Drilling the Trunnions of Reduction-gear Carrier-rings and a Flange Inside the Trunnions

automatically into contact with the work before the drilling commences. The movements of the jig plate and the tool-heads are derived from a hydraulic system.

The trunnions on these reduction-gear carrier-rings are finish-machined before being hardened on a Heald Bore-Matic, as shown in Fig. 14. They are machined two at a time, and 0.030 inch of stock is removed from the diameter. At the same time, the boss at the base of each trunnion is faced, and a radius is formed at the junction of the boss and trunnion. Carbide-tipped tools are used, and the machining time has been reduced to 11 minutes per part, as against 104 minutes required by the former method, or approximately 90 per cent. On the machine shown, indexing is performed manually, but another similar machine is available in which automatic indexing is employed, which operates without attention from the operator until the part is completed, when it stops until reloaded and restarted.

High-speed production of small cap-screws and similar parts is attained by the use of several Greenlee six-spindle automatics, which turn these parts out completely finished at the rate of 120 to 150 per hour. One of these machines is shown in Fig. 16 machining 1/4-inch cap-screws, 1 1/2 inches long, at the rate of 120 an hour.

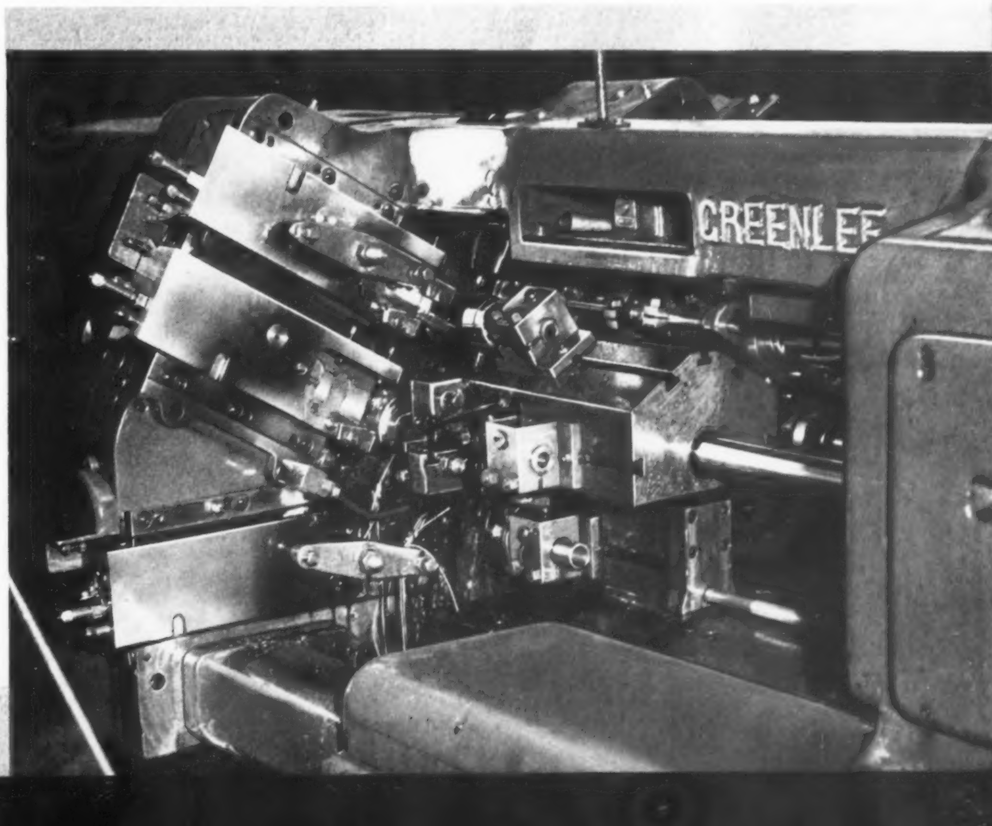


Fig. 16. Six-spindle Automatics Play an Important Role in Obtaining High Production for National Defense

LOCKHEED Concentrates on P-38

These Interceptors Fly at Speeds of Over 400 Miles an Hour and will Soon be Heard from in Europe's Battles—The Hudson Bombers Have Already Become Famous in the Defense of Britain

By R. A. VON HAKE
Vice-President in Charge of Manufacturing
Lockheed Aircraft Corporation

CONCERTED efforts are being directed this year by the Lockheed Aircraft Corporation, Burbank, Calif., toward attaining the greatest possible production of that concern's sensational new fighting plane known by the United States Army Air Corps as the "P-38 Interceptor" and by the British Royal Air Force as the "Lockheed Lightning." This plane has a speed in excess of 400 miles an hour, and is believed by many aviation authorities to be the world's fastest airplane. It is a heavily armed single-seater plane, and is driven by two Allison liquid-cooled engines. One of the most striking features of this plane is the speed with which it can rise off the ground to intercept enemy bombers.

The Lockheed Aircraft Corporation is also filling a large order of Hudson bombers for the British Air Forces. These planes have played a highly important role in Royal Air Force operations over Norway, Germany, Italy, and the "invasion" ports of Continental Europe. How remarkable their performance was will be realized when it is considered that these planes were originally designed as commercial transports, and were converted into reconnaissance bombers to meet Britain's dire need.

Great expansion of plant facilities had to be made last year in order to get ready for the production schedules of 1941. Today the Lockheed plant has a floor space of almost 1,600,000 square feet, and has approximately 30,000 employes on

Interceptors and Hudson Bombers

the payroll. Actually the number of students now taking the factory training courses is greater than the total number of factory employes a year ago. Lockheed's subsidiary, The Vega Airplane Co., has erected a new plant covering 1,290,000 square feet, which will be in full production during the summer. It will employ approximately 20,000 persons. This plant will be devoted to producing Ventura bombers for the British forces and Vega training planes.

Some of the manufacturing facilities recently provided at the Lockheed plant will be described in this article. In Fig. 2 is shown an Onsrud profile milling machine designed for handling extruded aluminum alloy stock, such as is used for main beams, up to 30 feet in length. Profile milling cuts can be taken in both vertical and horizontal planes, as the machine is equipped with three cutter-heads, one of which has a horizontal spindle, and the other two vertical spindles. These cutter-heads are mounted on a carriage which is fed along the stationary work-table. The operator ordinarily stands on a platform attached to the rear of the carriage as it moves back and forth, but the machine can also be started and stopped from the front.

One of the features that aids in obtaining high production is the provision of twenty-six air-operated clamps for gripping the long pieces of material. Clamping and unclamping are instantly effected by depressing push-buttons which control solenoid switches that actuate the valves of the clamp cylinders. With this equipment, reloading time is greatly reduced. The milling cuts are controlled from templets clamped to the front or back of the table, which have profile edges in either horizontal or vertical planes as required. Rollers

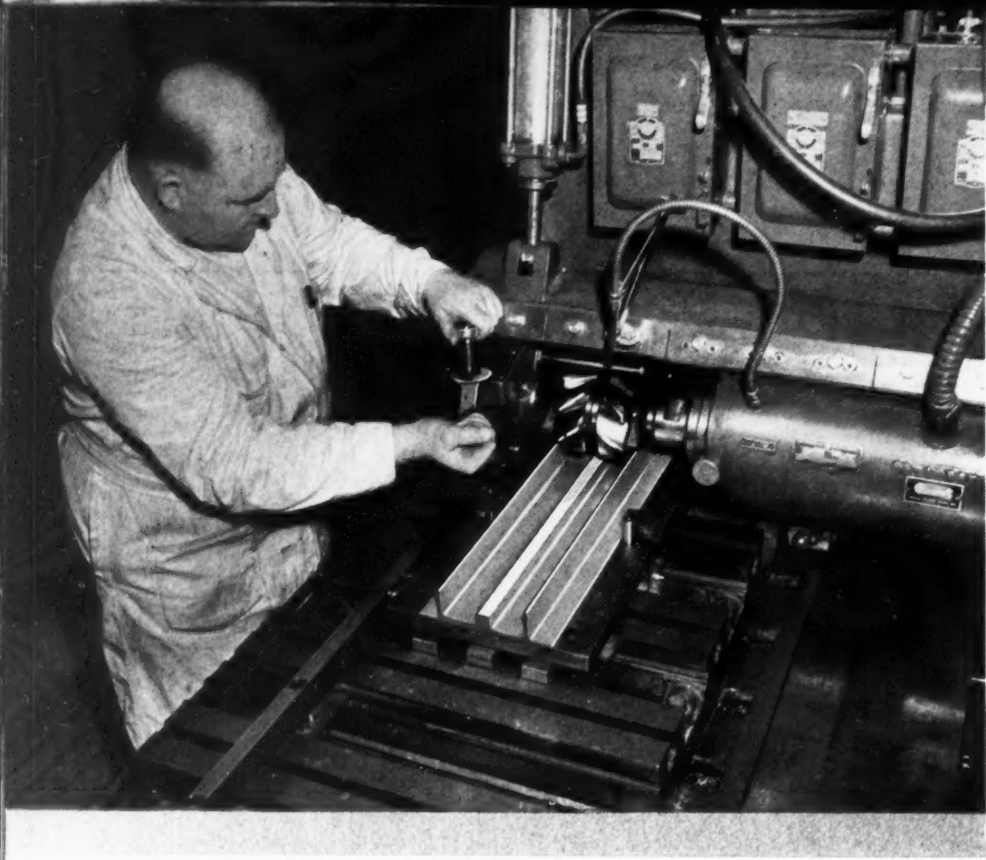


Fig. 1. (Left) Horizontal Cutter-spindle on the Profile Milling Machine Shown in Fig. 2, which is Equipped with Two Cutters for Milling Deep Channels in Extruded Beams

Fig. 2. (Below) Profile Milling Machine Equipped with Two Vertical-spindle Cutter-heads and One Horizontal-spindle Cutter-head for Taking Cuts on Long Main Beams and Similar Parts

mounted on the cutter-heads ride along these profile or cam bars and cause the heads to move in and out, or up and down, in accordance with changes in the profile. The rollers are held in contact with the cam bars by air pressure. A close-up view of the horizontal-spindle head is shown in Fig. 1, and a view of the vertical-spindle heads is seen in Fig. 3.

During the milling of a main beam or similar part, the feed of the milling heads is automatically changed for deeper or lighter cuts, so as to guard against overloading of the individual driving motors, and at the same time, permit milling to maximum depths. Cuts are taken to a depth of about 3/4 inch. The cutter-spindles are run at speeds up to 10,000 R.P.M. The motors that drive the cutter-spindles receive high-frequency electric current from a bus-bar that is constructed along the top of the machine, as seen in Fig. 2. Although one horizontal-spindle cutter-head is provided on the right-hand end of the carriage only, provision has been made for mounting a second head of this type at the left-hand end as well. The cutter-heads are driven by 15-H.P. motors.

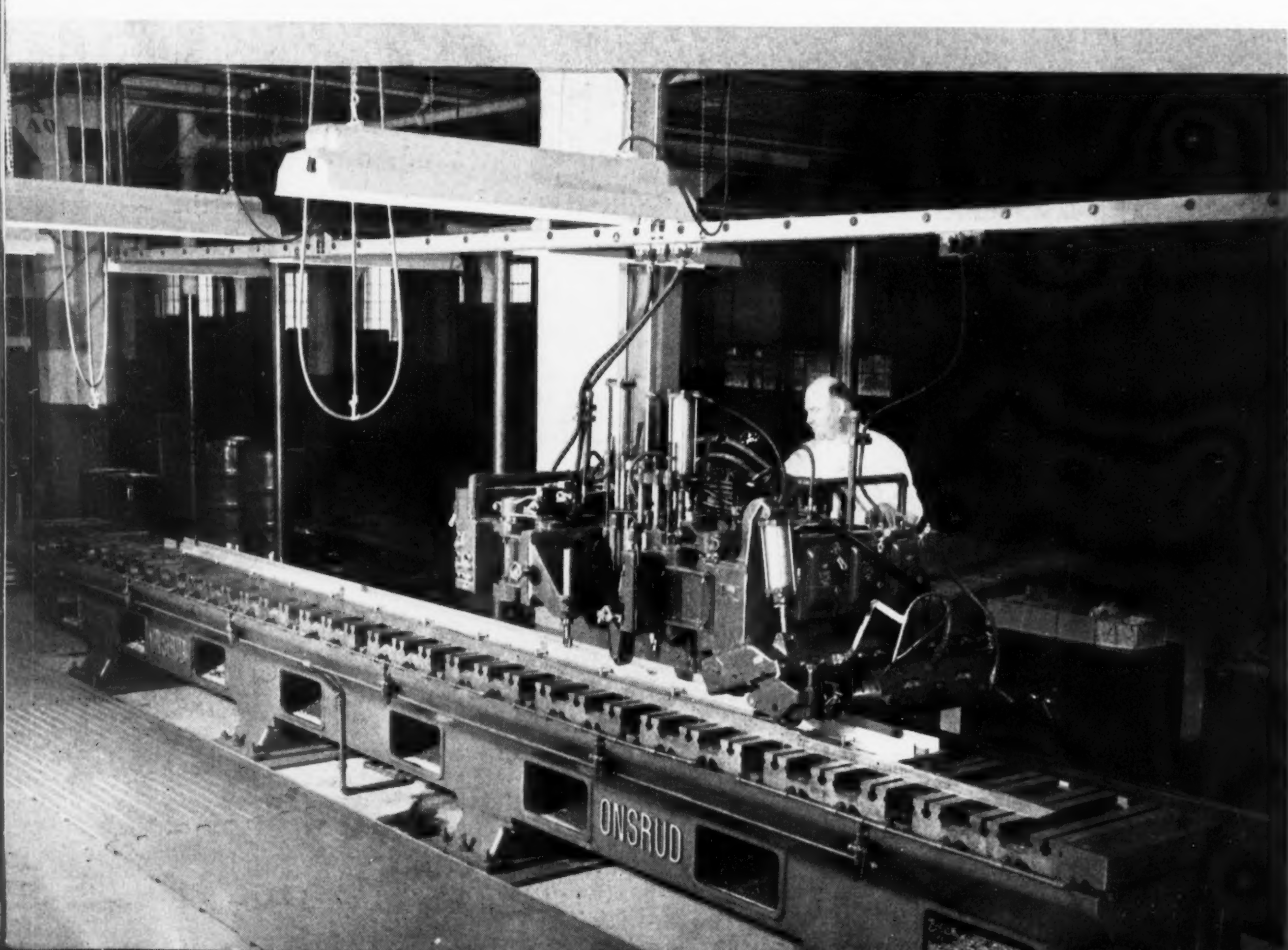


Fig. 3. (Right) Close-up View of the Two Vertical Cutter-Spindles and of One of the Rollers that Control Their Vertical Movement as They Feed Along the Work

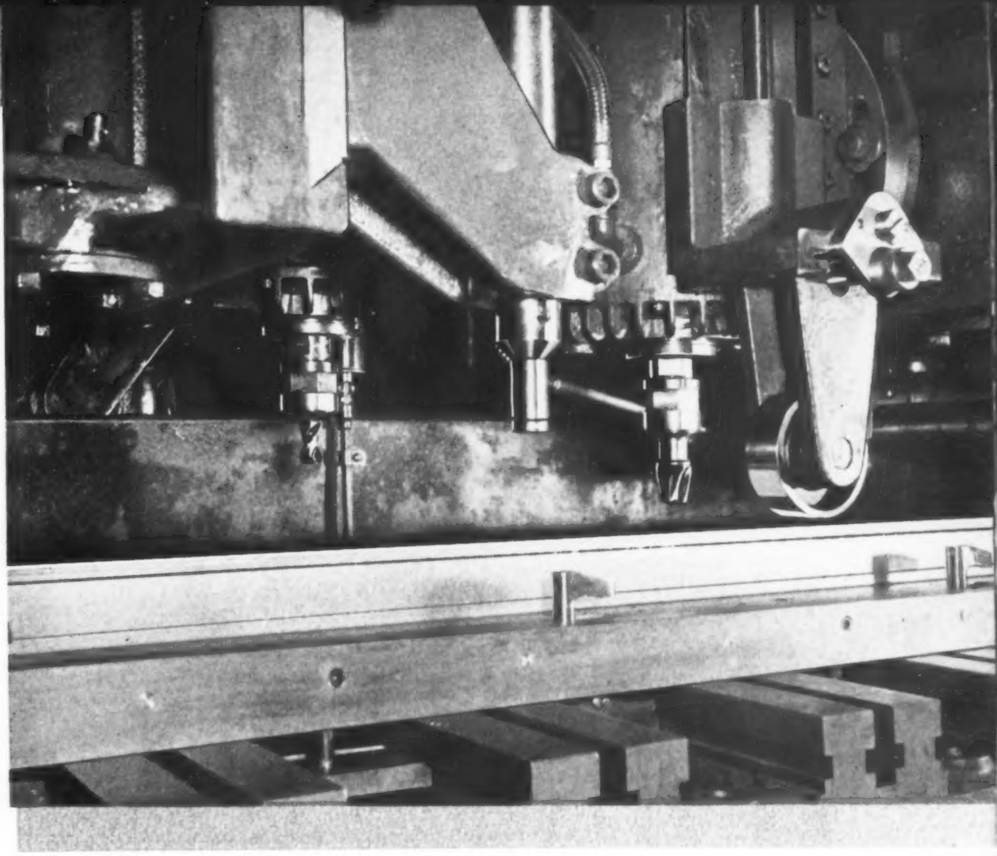


Fig. 4. (Below) Four X-ray Machines which are Completely Automatic in Operation and Enable 20,000 Pieces of Work to be Inspected by the X-ray Process in an Eight-hour Day

Two Lindberg electric furnace units have been installed for heat-treating aluminum alloy parts after they have been formed, rolled, etc., into the desired shapes. Hundreds of these parts are loaded at one time on racks of the type shown in Fig. 6, which are provided with casters so that they can be rolled quickly into the furnaces and the doors closed before much heat is dissipated into the room. Each rack is approximately 14 feet long, 6 feet high, and 3 feet wide. The work pieces are suspended by wires from small-diameter bars in such a way as to avoid contact with one another.

The loaded rack remains about 30 minutes in the furnace, during which time the parts attain a temperature of approximately 920 degrees F. Then, without being exposed to the room atmosphere, the rack is pushd into a "fogging" chamber connected to the discharge end of the furnace, where it remains for 10 seconds. From the view of this chamber shown in Fig. 5, it will be seen that pipes extending along the walls, the ceiling and below the floor grating are fitted with a series of nozzles that eject water so finely atomized as to cause a heavy fog all around the heated parts, thus imparting to

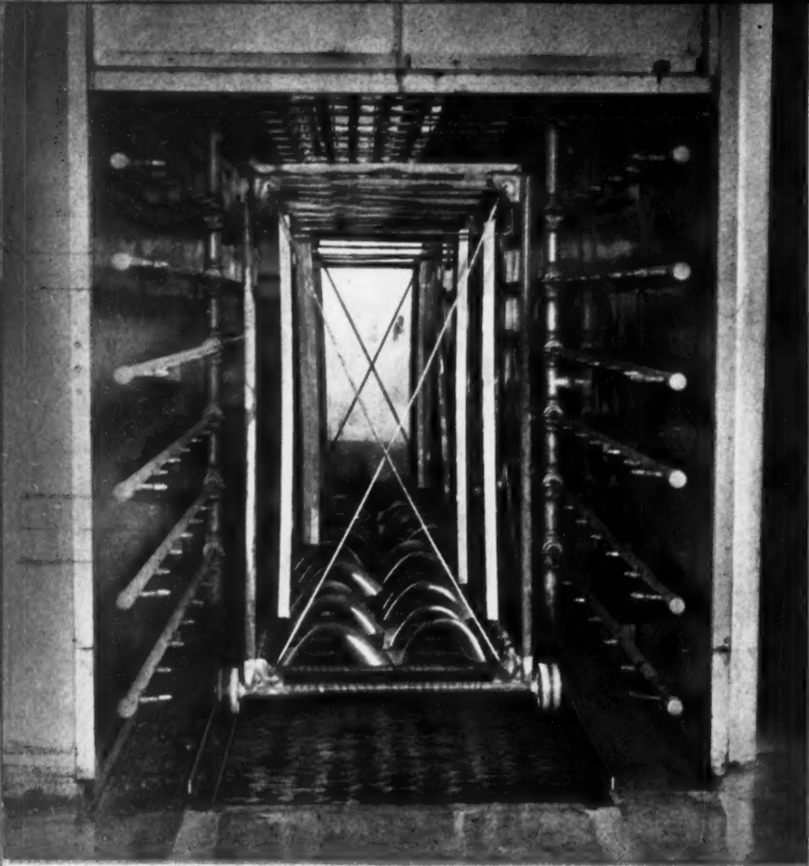


Fig. 5. View of Fogging Chamber at the End of a Heat-treating Furnace, in which the Work Pieces are Completely Surrounded by Atomized Water

them the desired physical characteristics. All together there are about 400 nozzles for directing the atomized water on the load of work. The door between the furnace and the fogging chamber, as well as the loading door of the furnace and the discharging door of the fogging chamber, is raised and lowered by the operation of air cylinders. The heated racks are pushed from the furnace into the fogging chamber by incoming racks of new work.

Much time and labor are being saved in painting the hundreds of aluminum-alloy pieces that enter into airplane construction by the use of the two automatic conveyor type paint-spraying machines seen in Fig. 8. The loading end of one machine is seen in the foreground, and the unloading end of another machine in the background. Each machine is provided with a mesh conveyor, 4 feet wide, that runs 15 feet per minute. This conveyor carries the pieces of work through a booth in which a De Vilbiss paint spraying unit is constantly fed back and forth on an overhead track, effectively spraying every square inch of work that passes beneath. Heavy wrapping paper is ordinarily fastened around the conveyor for its full length to take up the excess paint.

When the painted parts leave the spray booth, they pass under a battery of infra red electric lights—256 of them—which dry the paint from the metal surface outward instead of from the outside in. A view of these lights is seen in Fig. 7.

After the work pieces pass from under these drying lights they are transferred to the adjacent painting machine and placed upside down on the conveyor belt for painting the opposite side during passage through that machine. Pieces so small that they might fall through the links of the conveyor belt are placed 150 at a time on wire trays of finer mesh.

All aluminum castings and forgings that are highly stressed in service and 10 per cent of all other aluminum castings and forgings are inspected by X-ray to detect any flaws. This work is performed in the X-ray department of the Trip-

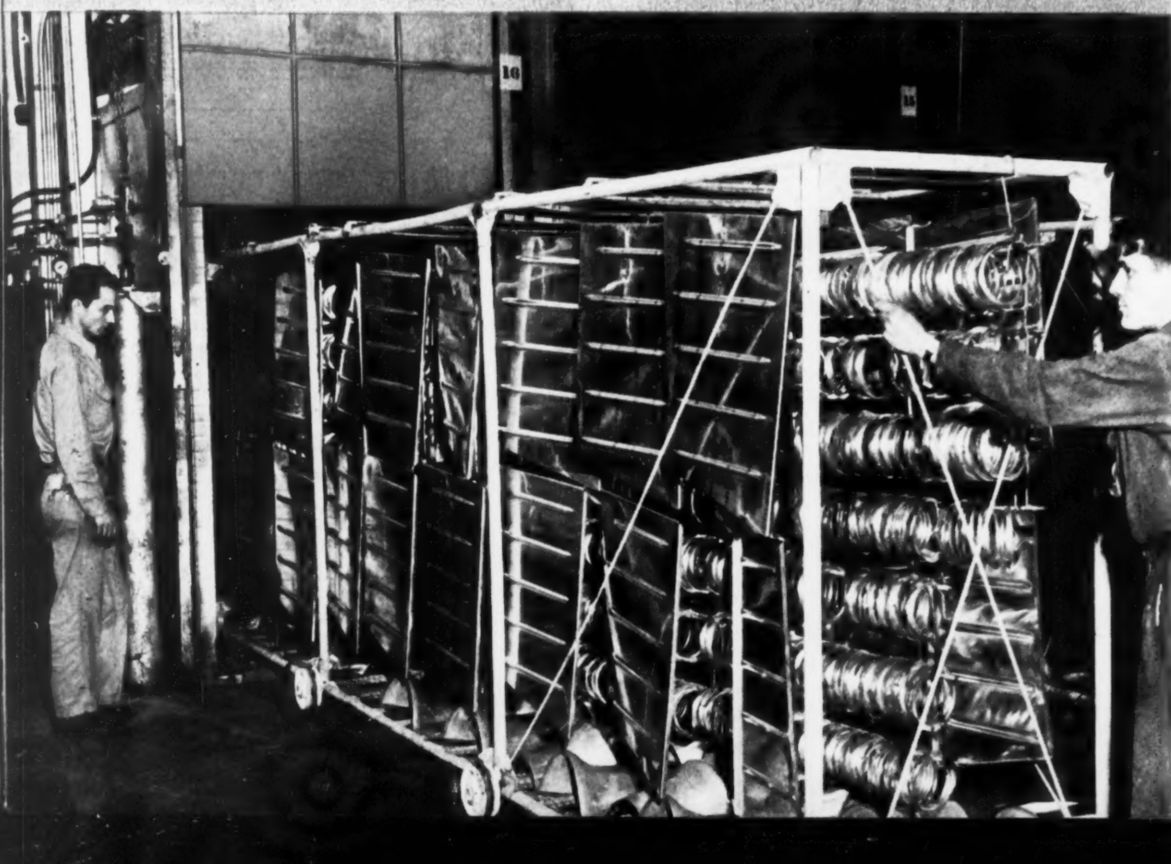


Fig. 6. Large Rack of Aluminum-alloy Sheet-metal Parts being Put into an Electric Furnace for Heat-treatment

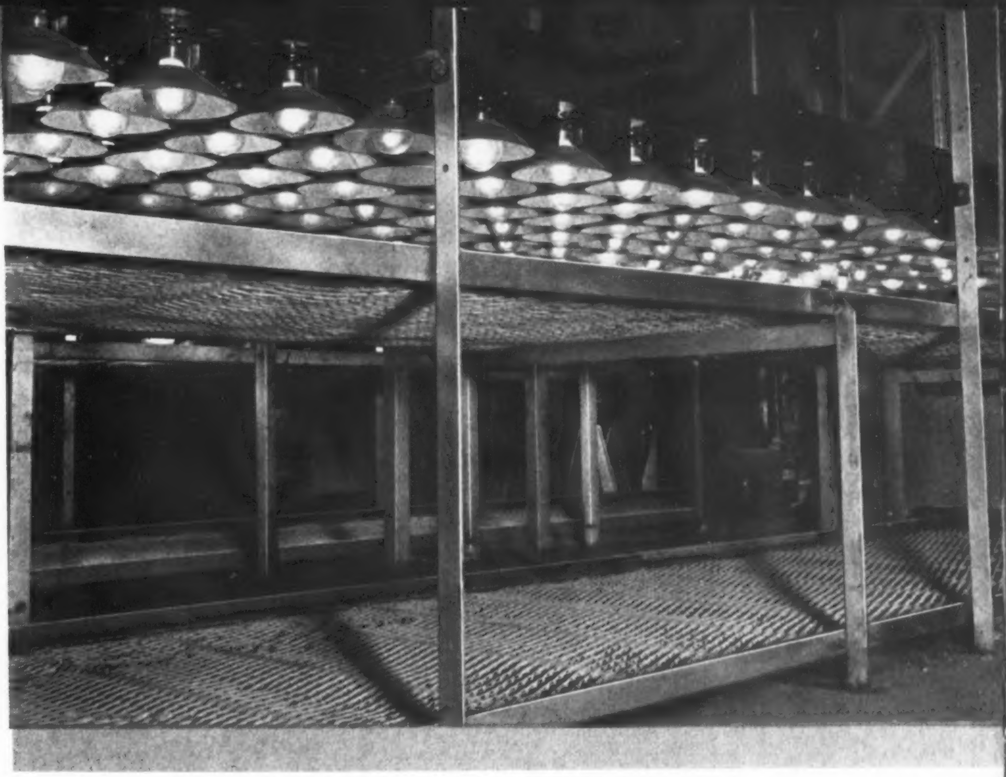


Fig. 7. Infra Red Lamps—256 of Them—Thoroughly Dry the Work Pieces as They Pass from the Spraying Booth of the Machines Shown in Fig. 8

lett & Barton Laboratories, which are located in the Lockheed plant. Four automatic X-ray machines perform this inspection on a real production basis, these machines being capable of X-raying at least 20,000 parts in an eight-hour day.

The castings and forgings to be X-rayed are brought to these automatic machines on rack type trucks, and are placed on a sliding table, as seen at the left of the right-hand machine in Fig. 4. Each table is provided with two platens, one of which can be loaded while the other is in position for X-raying work already loaded. When the preceding inspection has been completed, the sliding table is automatically moved into place under the X-ray lamp within the hood that is seen raised. The hood descends over the work, the X-ray photograph is taken, the hood is lifted again, and the work is moved from under the X-ray lamp, all automatically. The work-table moves alternately to the right and left of the X-ray lamp. A negative is made every minute on the average, usually with a number of parts in the exposure.

These automatic X-ray machines are used principally on light aluminum pieces, whereas bronze and steel parts, welded work, and heavy castings are sent to other X-ray machines of greater capacity, located in separate rooms of the laboratory. An X-ray machine of 680,000 volts capacity has recently been installed to handle large work. X-ray negatives 14 by 17 inches are used on all machines.

Automatic drilling units are saving many hours in drilling the thousands of rivet holes that must be produced in aluminum alloy sheets. With these units, the operator merely pushes an electric button

Fig. 8. Conveyor Type Paint-spraying Machines with Automatic Spraying Units for Handling Large Quantities of Work

Fig. 9. Drilling of the Thousands of Holes in Aluminum Alloy Sheets has been Speeded up by the Use of This Automatic Drilling Unit

to start the automatic feeding of the drill after it has been located correctly on the work. A close-up view of one of these automatic drilling units is shown in Fig. 9. When the operator pushes the button, a solenoid switch is operated to cause air to be admitted into a pneumatic cylinder for quickly feeding the drill head down to the work.

Drilling is accomplished in two strokes of the drill spindle, the drill being withdrawn from the hole when it is half way through, to permit it to free itself of chips. At the end of the second drilling step, the air cylinder quickly "snaps back" the drill spindle to the starting position. With this speedy equipment, an operator drills as many as 190,000 holes in an eight-hour day, whereas with a hand-fed unit, a production of 4500 holes was considered a good day's work.

The sheets to be drilled are stacked to a thickness of about 7/16 inch on the table. With the thinner sheets, this means twelve to fifteen sheets, and with the thicker material five to seven sheets. A templet is clamped on top of the stacked sheets, and a conical finder attached to the lower end of the drilling unit is quickly positioned in the templet holes to locate the drill unit for each step of the operation. The drill spindle is driven at 14,800 R.P.M. by a 5-H.P. high-frequency motor.

Elaborate equipment is not always necessary in order to effect savings in time or attain desired results, as will be apparent from Fig. 10, which shows a simple machine designed for washing and drying blanked metal pieces and also removing the burrs from the blanked edges. The operator at the left first places the metal pieces in a shallow pan of water, and then feeds them under sprays of water and between two strips of rubber through which air is discharged under pressure. The compressed air and the rubber strips together remove all

Fig. 10. Simple Equipment Devised for the Washing, Drying, and Deburring of Sheet-metal Pieces Blanked in Hydraulic Presses

Fig. 11. Finishing Chromium-plated Landing-gear Fulcrum Tubes within a Tolerance of 0.0005 Inch on a Centerless Grinder

water. The work pieces are then pulled between two steel cylinders which flatten down the burrs, leaving straight, clean edges.

One of the new machine tools installed in the machine shop during the last year is the Cincinnati centerless grinder shown in Fig. 11. The operation illustrated consists of finishing landing-gear fulcrum tubes to a diameter of from 1.9960 to 1.9965 inches. The tubes are 10 inches long. This operation is performed after the tubes have been heat-treated and chromium-plated to a thickness of from 0.002 to 0.003 inch. The tubes are also ground in this machine immediately after the heat-treatment and before they are plated. The threads seen on the parts are ground after chromium-plating.

The fly cutting principle is widely applied in the Lockheed machine shop for finishing flat surfaces an aluminum forgings and castings. The flexibility of this tooling principle permits its application to an almost endless variety of work, and surfaces can be finished to a high degree of smoothness and straightness. Another advantage is that the original cutter cost is low and the cutters can be quickly resharpened. Carboloy cutters are commonly used.

Fly cutting is performed on milling machines and horizontal boring mills, the operation illustrated in Fig. 12 being performed on a Lucas boring, drilling, and milling machine. The work piece is a forged duralumin boom fitting, and in the set-up shown, two opposite faces are finished. The cutter runs at 1200 R.P.M., and is located on a 7-inch circle which gives a peripheral cutting speed of about 2000 feet per minute. On the table is shown one of the work pieces as it comes to the machine and in front of it a finished piece after a series of operations performed in different set-ups on the boring mill in which fly cutters are used for all cuts except boring.

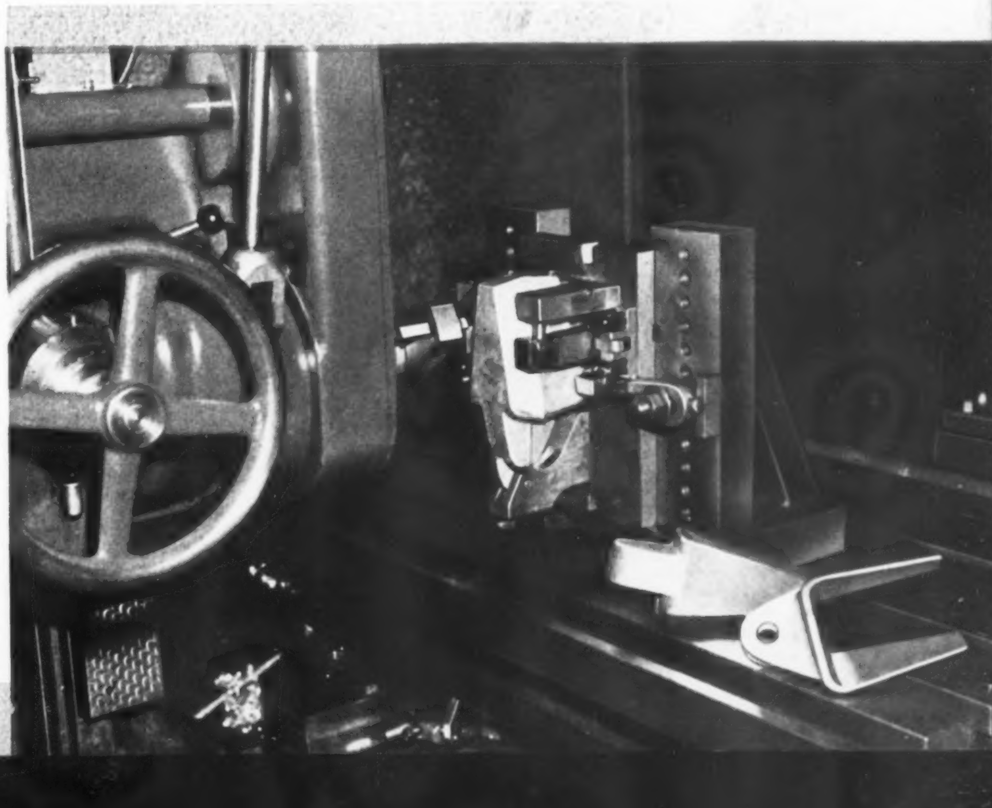
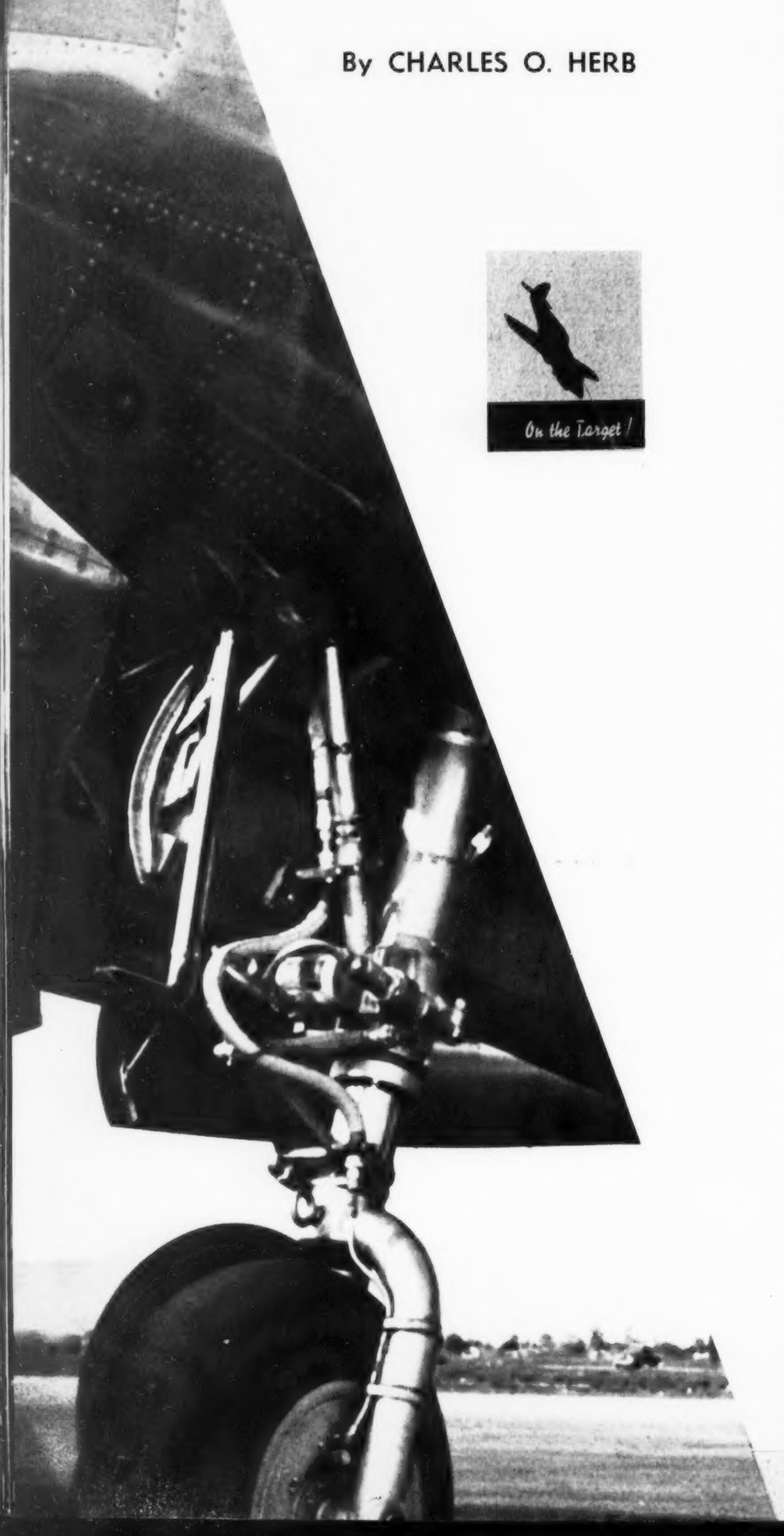


Fig. 12. Fly Cutting is Used Extensively in the Lockheed Machine Shop because of its Flexibility and Other Advantages of This Type of Tooling

MENASCO'S Advanced Methods

Main and Nose Struts for the Hydraulic Landing Gear of Lockheed P-38 Interceptor Planes are Manufactured in a New Shop Completely Outfitted with Latest Equipment

By CHARLES O. HERB



ONE of the most modern shops on the Pacific Coast from the standpoint of machine tools is the new plant of the Menasco Mfg. Co., erected last year at Burbank, Calif. This plant was established for the production both of Menasco in-line air-cooled engines, widely used on training and sport planes, and of hydraulic landing-gear struts for the Lockheed P-38 interceptor planes. Of the two shops into which the plant is divided, the one devoted to the manufacture of engines is equipped with new machine tools and with others brought from the previous plant of the concern. The landing-gear shop is completely furnished with new machine tools, welding machines, and heat-treating equipment that was specifically purchased and tooled up for manufacturing main and nose struts.

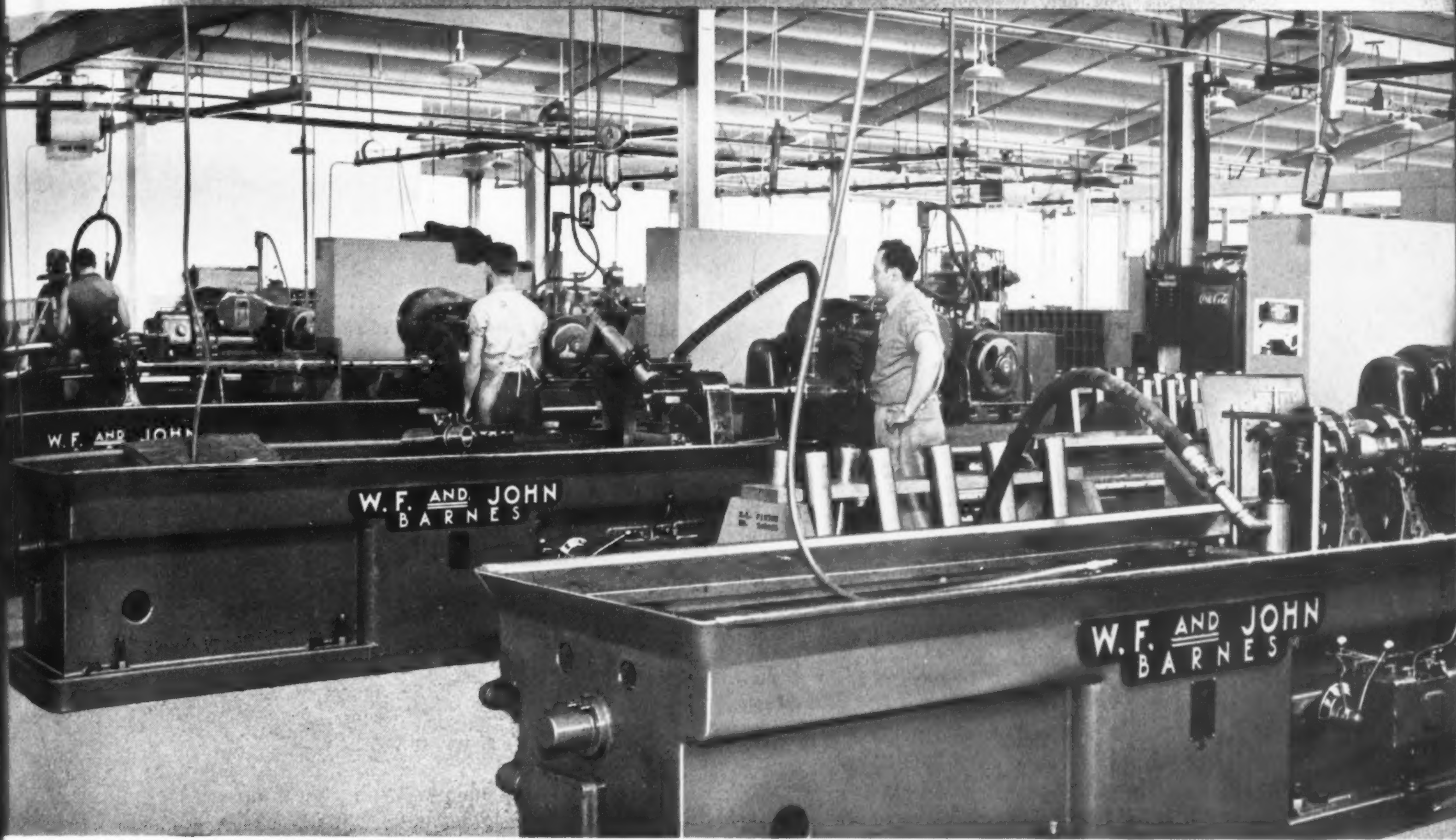
The methods followed in the landing-gear shop will be described in this article. As the procedure in machining parts for the main and nose struts is practically the same, similar operations on these two parts will be described only once.

One of the first operations on the main strut consists of rough-turning it on a Monarch engine lathe equipped as illustrated in Fig. 1, after which it is finish-turned on the same machine. In both operations, the cutter is fed along the desired path on the part through the use of a profile bar or cam mounted at the rear of the machine as shown.

Tungsten-carbide tools are used in rough- and finish-turning this chromium-molybdenum part, which was swaged from seamless-steel tubing. In rough-turning, the work is rotated at 241 R.P.M., which gives a surface speed of 330 feet a minute at the maximum diameter. The depth of cut is about 3/16 inch, and the feed 0.015 inch. In finish-turning, the work is rotated at 320 R.P.M., which is equivalent to a surface speed of 440 feet per minute at the maximum diameter, and the depth of cut is 1/32 inch, the rate of feed again being 0.015 inch. The tailstock end of the work is supported on a large ball-bearing cone, which is mounted on a live center.

The next operation on the strut consists of rough-boring the oil chamber, the cylinder portion, and two surfaces that are later threaded, there being four different diameters. This operation is performed on a hydraulically actuated machine built by the W. F. & John Barnes Co., which is illustrated in Fig. 2; this illustration, however, shows a finish-boring operation that is performed after lugs have been welded to the outside of the strut. For boring struts of different lengths, tool-bars from 72 to 108 inches long are used. They are fitted with tungsten-carbide cutters. The work

Manufacturing Landing Gear



is held stationary during the operation, and the tool-head is moved hydraulically toward the fixture to feed the revolving boring-bar through the work.

The boring-bar is passed completely through the work before any cutting starts, so that it can be piloted in a bushing of the tailstock seen at the left. Cutting oil is fed to the cutters through the inside of the boring-bar to wash out all chips from the work. Forty gallons of oil are pumped per minute.

In certain cases, the cylinder chamber of the struts is bored in an Axelson engine lathe, set up as shown in Fig. 3. This machine is also employed for finishing the packing-gland bore in the extreme rear end of the strut. The boring-bar is firmly supported in a heavy split block which is mounted on the regular compound rest of the machine. This illustration also shows an operation on a strut after the lugs have been welded on.

The welding of the lugs to the outside wall of the struts is performed immediately after rough-boring. To insure proper location of the lugs, use is made of a fixture such as is illustrated in Fig. 5. One of the lug members goes only half way around the strut, but the other is in the form of a sleeve, and must be slipped on from the small end of the strut. Each lug member has two ears, previously machined. Strap members on the fixture are placed between each pair of ears to insure their accurate location relative to each other and with respect to the center line of the strut. Clamping screws tend to push the strut toward the left, and thus insure accurate location of the work from the large-diameter end. The lug members are merely tack-welded to the strut while in this fixture, use being made of a Lincoln "Shield Arc" electric welder.

The tack welds are next ground smooth to eliminate any high spots after the final welding is performed. Then the surfaces to be welded are coated with a spatter film, and the struts are passed through an electric oven similar to the one shown in Fig. 7 to be preheated prior to complete welding of the lug members. This furnace, which was built by the Acme Blower & Pipe Co., Los Angeles, Calif., is equipped with two conveyors which automatically carry the struts through the furnace and discharge them at the opposite end after they have obtained a temperature of about 300 degrees F. The furnace doors open and close automatically.

Welding of the lug members to the struts is completed with the work mounted on a revolving fixture that carries the lug members slowly past an electrode. Upon the completion of this operation, the welds are carefully inspected by the Magnaflux method to reveal any defects, this being the first

Fig. 5. Fixture which Accurately Holds Lug Members in Position on Main Struts during a Tack-welding Operation that Precedes Complete Welding of Lug Members

machine, which is illustrated in Fig. 4. The toolhead is arranged to reciprocate under the close control of hydraulic valves that are operated by Micro switches. At the front end of its stroke in honing one bore, the hone must stop against a shoulder. From 0.005 to 0.006 inch of stock on a side is removed in rough-honing, and about 0.0005 inch of stock in finish-honing. A mixture of kerosene and International honing compound is applied to the hone, and the latter is constructed with six abrasive stones. The purpose of this honing operation is to obtain a mirror finish on inside surfaces, entirely free from minute tool marks that might develop into cracks when the strut is in service.

Three threads are now tapped in the strut in an operation performed on another W. F. & John Barnes machine of the same type as those previously mentioned, but which is equipped with Murchey tapping bars such as seen on the machine in Fig. 10. The tapping bars are 62 inches long over all. They are provided with bronze guides which are piloted in a finished bore of the strut. Threads 2 1/2, 4, and 4 1/2 inches in diameter, sixteen per inch, are tapped to a Class 3 fit.

Three external surfaces are next ground for lengths of about 5 inches to create specified wall thicknesses and to reduce the weight of the struts as much as possible. This operation is accomplished on the Landis cylindrical grinding machine shown in Fig. 11. The two large diameters must be held to size within 0.001 inch, even though they are later painted over, but the small diameter seen at the right-hand end is held to the specified dimension within plus or minus 0.0002 inch. The work is supported on ball-bearing centers at each end.

Threads are ground on the large end of the main strut, right from the solid stock, by means of the Ex-Cell-O thread grinder illustrated in Fig. 12. This machine is also employed to grind threads on the nose strut, the main and nose pistons, and the axle piston sleeve, all to Class 3 fits. The threads range from 3/4 inch, eighteen per inch, up to 5 1/4 inches diameter, sixteen per inch. Threads

Fig. 6. The Modern Heat-treating Department Includes Two Electric Furnaces, a Quench Tank, and a Work-protecting Hood

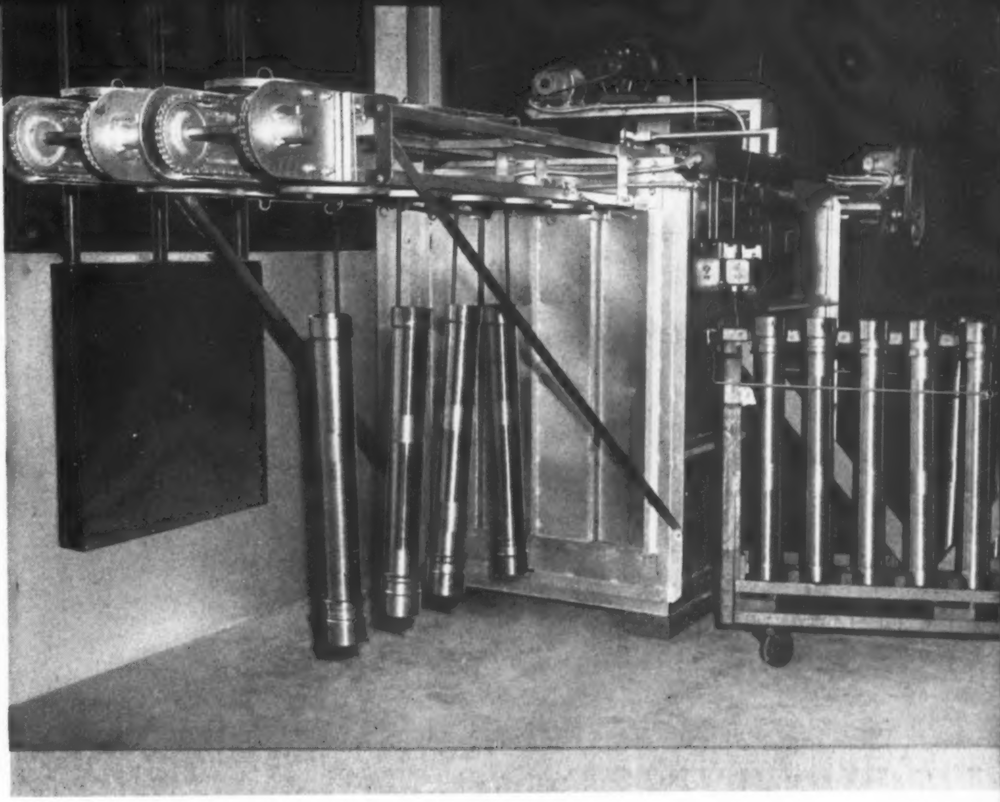


Fig. 7. Completely Automatic Electric Oven Used for Preheating the Landing-gear Struts prior to Welding and also for Handling Other Work in Brazing Operations

3/4 or 7/8 inch in diameter are completely ground in one pass of the wheel, but larger diameter threads are produced in two passes of the wheel. An axle piston sleeve on which threads have been ground is seen lying at the front of the table.

The lugs on the struts are next straddle-milled on a Milwaukee Simplex machine, set up as shown in Fig. 13, which shows a nose strut being milled. The inside and outside surfaces of two lugs are milled at one time, this operation being a finishing one, as the lugs were rough-machined before being welded to the struts. This is considered a particularly good milling operation because of the hardness of the work. Each inner-lug face must be the required distance from the center line of the strut within 0.001 inch.

The same fixture is employed for milling the lug seen near the center of the nose strut at right angles to the lugs at the right-hand end. For this second operation, the work is turned to a position located at 90 degrees to the position shown, and a swinging bar is placed between the lugs that were milled in the first operation, so as to locate the strut accurately. Different cutters are provided, it being the practice to run a group of bars through the first operation, and then the same group through the second. On the main strut, the two sets of lugs are in line and are milled in one set-up. The operation of the milling machine is completely automatic.

Seven holes are drilled in the main struts by using the Carlton radial drilling machine shown in Fig. 8, with the work held in a jig that can be indexed through 90 degrees. The jig is locked in its two settings by manipulating a handle on the base, which causes plugs to enter holes in indexing members at the opposite ends of the jig. The small end of the strut is held in a V-block at the left-hand end, while the large end is seated on a block, mounted on a slide which can be moved back and forth on ways of the jig.

The packing gland chamber in the large end of the main and nose struts is finish ground on a Heald internal grinding machine, as illustrated in

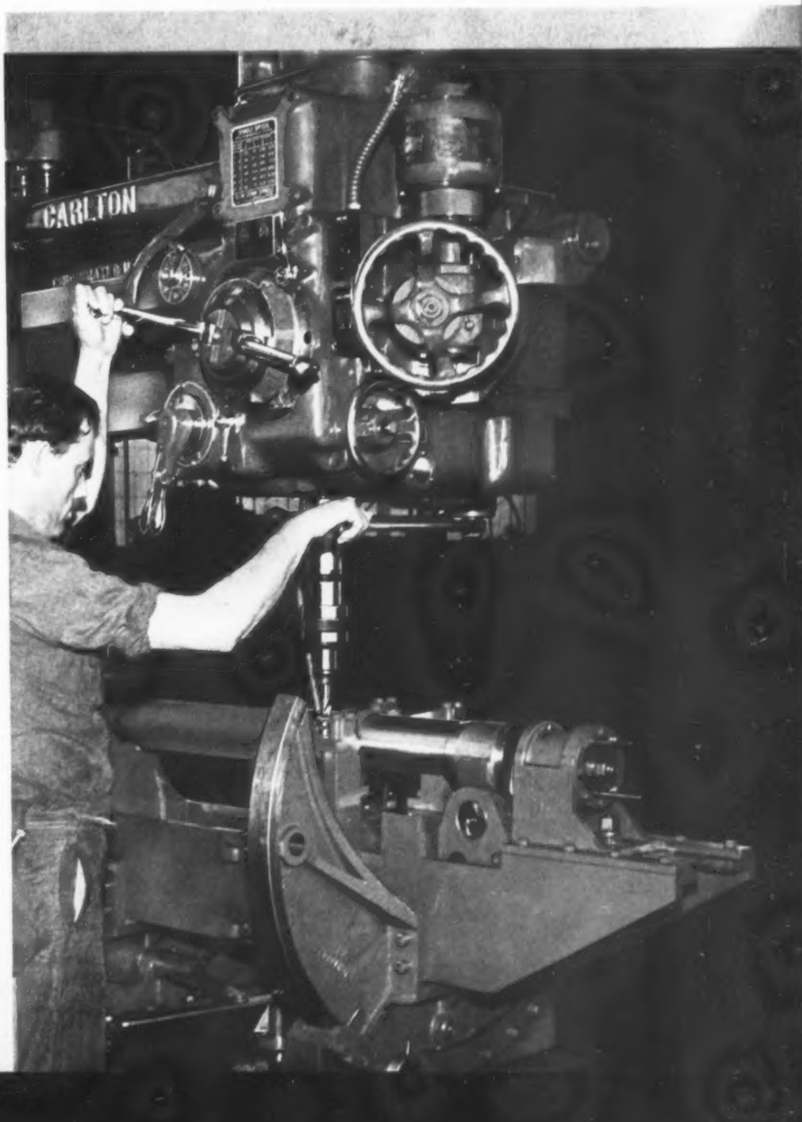


Fig. 8. Fixture that Enables Seven Holes to be Accurately Drilled in Main Struts, by Means of a Radial Drilling Machine

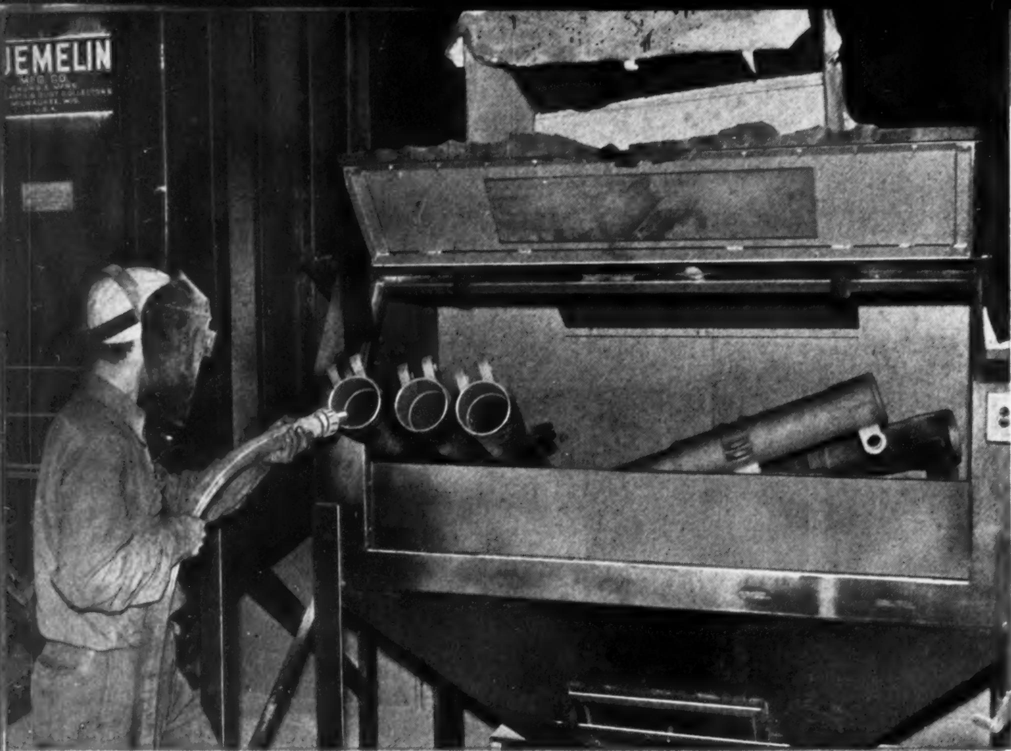


Fig. 9. The Landing-gear Struts are Sand-blasted Inside and Out after Tempering to Remove Scale and Prepare Them for Magnaflux Inspection

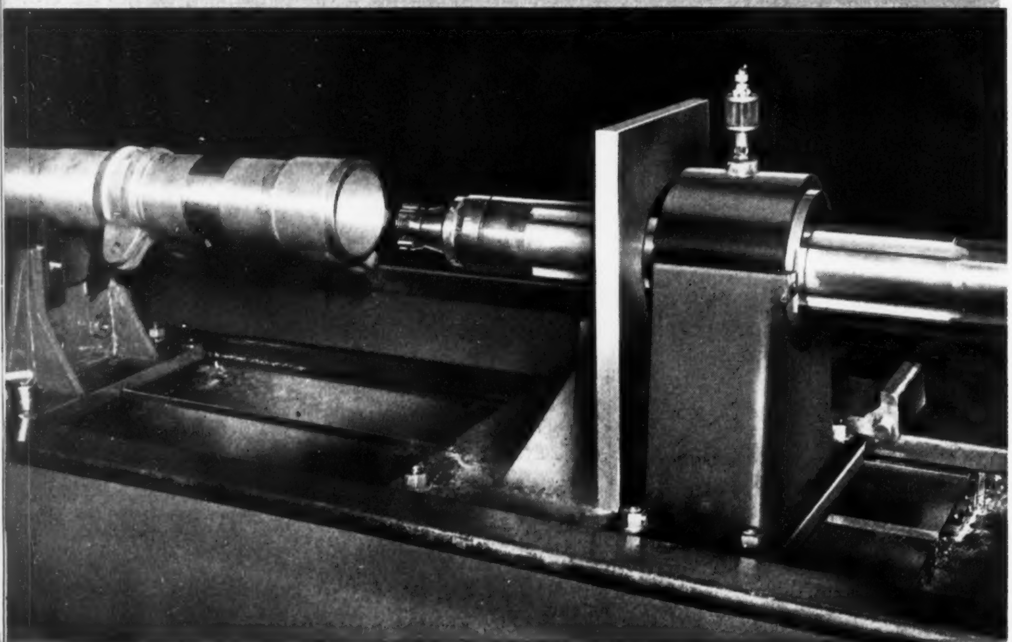


Fig. 10. Hydraulically Actuated Machines Equipped with Long Tapping Bars are Employed to Produce Three Internal Threads in the Main Struts

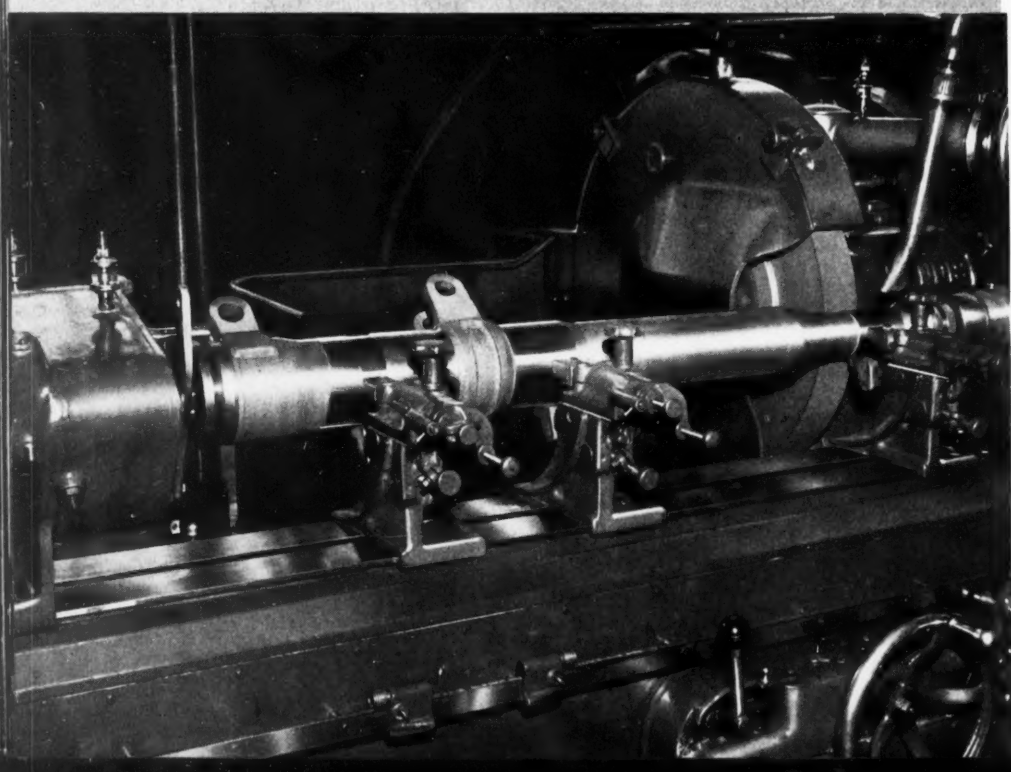


Fig. 11. Three External Surfaces are Ground on the Main Struts by the Cylindrical Grinding Machine Here Shown

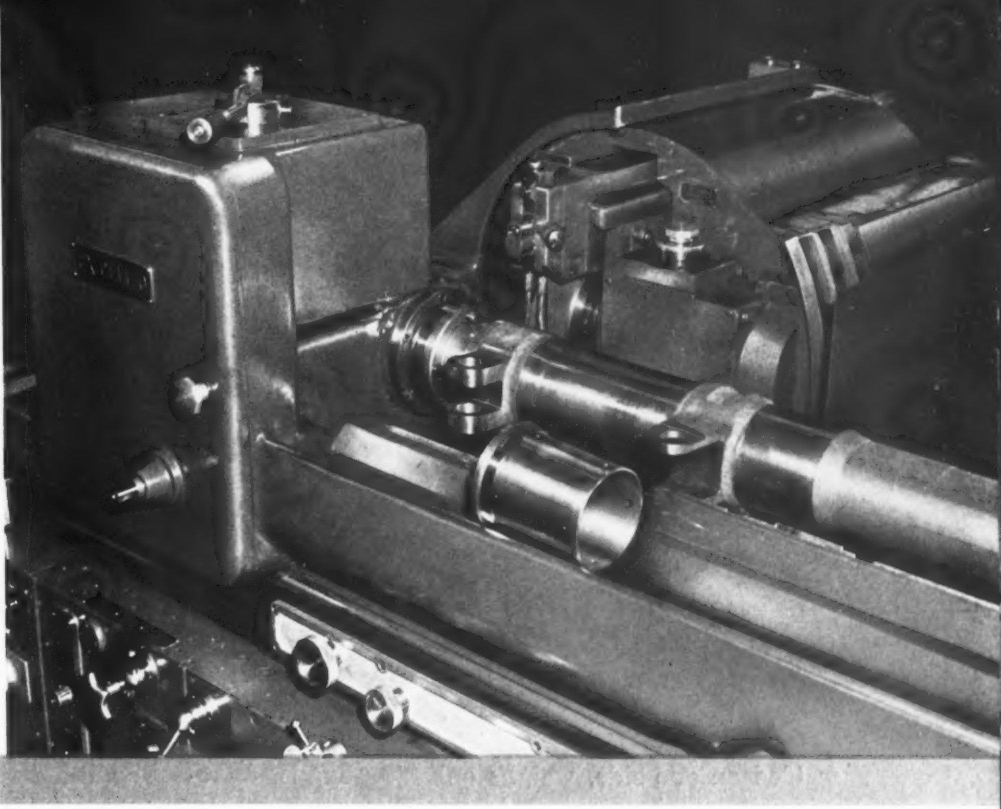


Fig. 12. Grinding Threads on the Large End of a Main Strut from the Solid Stock. On the Table is Seen an Axle Piston Sleeve on which Threads are Also Ground

Fig. 14. The chamber diameter, which is approximately 5 inches, must be held to within 0.001 inch of size. The surface ground is about 5 inches long.

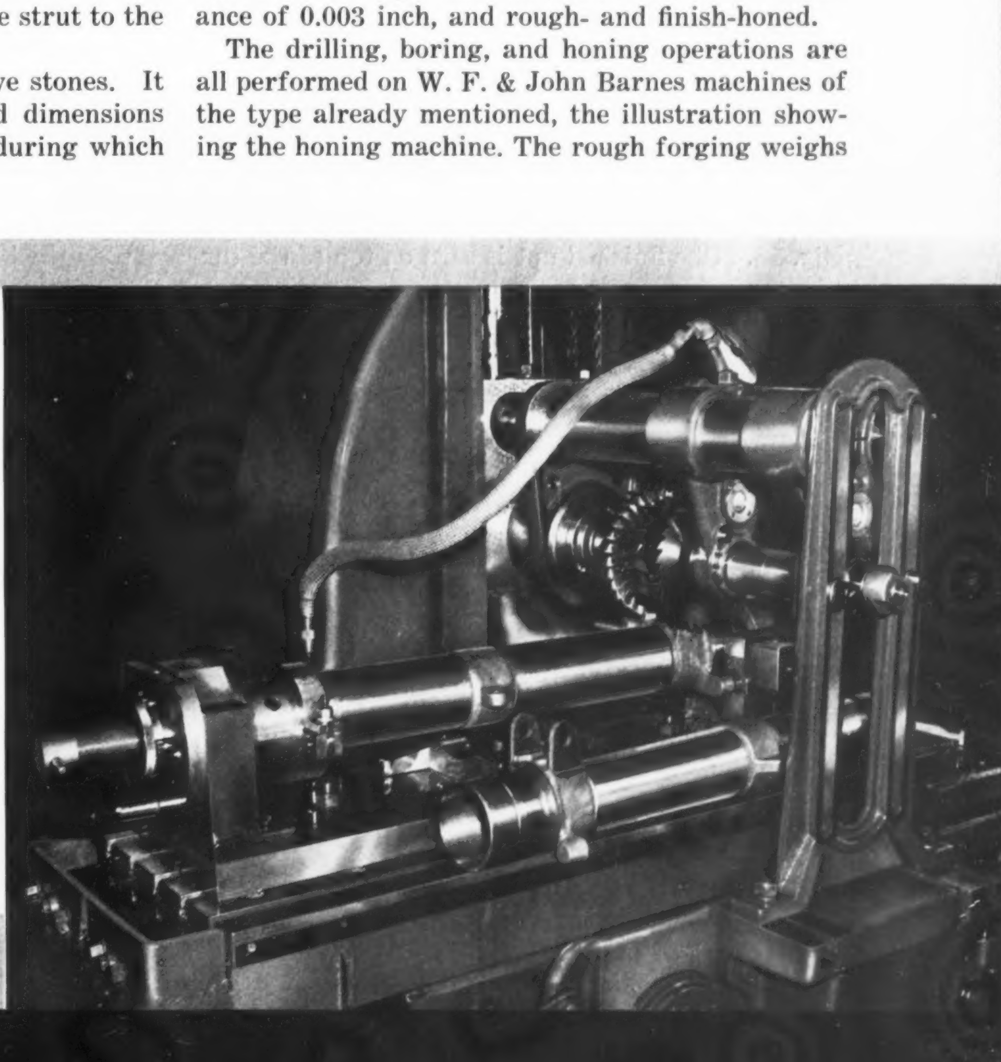
The holes that were previously drilled through the lugs of the main and nose struts must be finished by honing in order to insure a tight fit of the assembly bolts and to remove all tool marks. This operation is performed by the Micromatic Hydrohoner shown in Fig. 15, which is equipped with a fixture that slides crosswise of the machine to locate the two sets of lugs in line with the hone. The sliding member of the fixture is made with an inclined surface to compensate for the difference in the distance from the center line of the strut to the center of the two lug holes.

The hone is made with four abrasive stones. It finishes the lug holes to the specified dimensions within 0.0005 inch in one operation, during which from 0.001 to 0.0015 inch of stock on the diameter is removed. A similar operation is performed on the cross-bore holes of the landing-gear pistons.

While the main and nose struts or cylinders are produced from swaged tubing, the pistons that operate in them are machined from solid forgings. At the left in Fig. 16 may be seen one of the rough piston forgings and a finished piston. These pistons are also made of chromium-molybdenum steel. They are first drilled to a diameter of 2 inches, after which a core drill 3 1/4 inches in diameter is employed to open up the hole to the closed end. This hole is then rough- and finish-bored within a tolerance of 0.003 inch, and rough- and finish-honed.

The drilling, boring, and honing operations are all performed on W. F. & John Barnes machines of the type already mentioned, the illustration showing the honing machine. The rough forging weighs

Fig. 13. Simultaneously Milling Both Sides of the Lugs at One End of a Nose Strut, the Same Fixture being Employed for Grinding a Lug near the Center of the Part



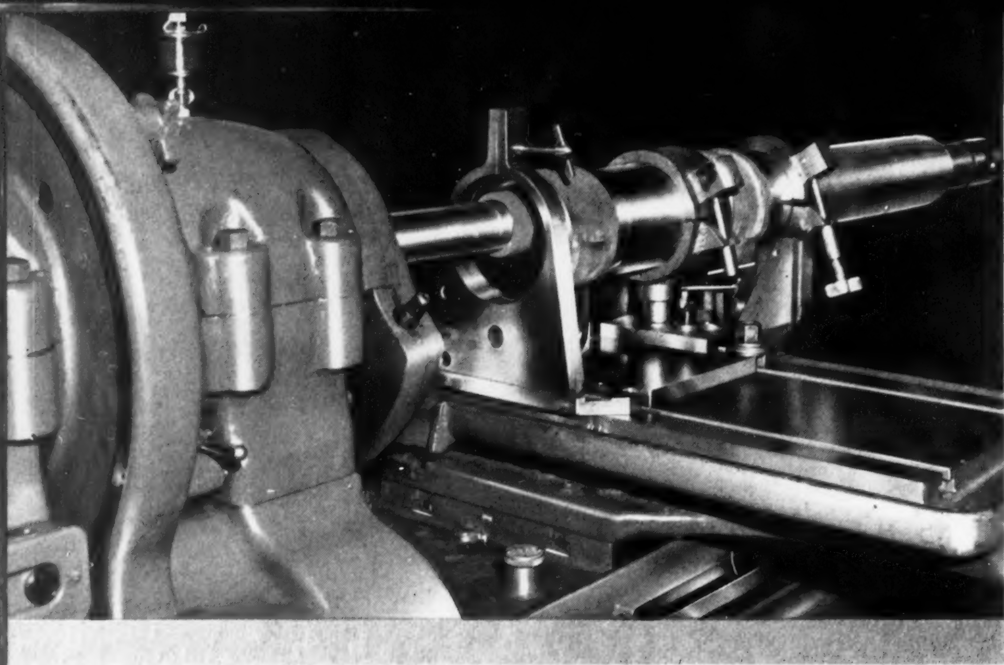


Fig. 14. Grinding the Packing Gland Chamber in the Large End of a Main Strut with One End of the Work Firmly Gripped in a Special Fixture

126 pounds, and the finished forging, with a flange welded on one side, weighs only 28 pounds. Likewise, the main strut weighs 168 pounds in the rough, and only 45 pounds finished, with two lug forgings welded on. All together, forty-eight operations are performed in machining the main struts.

The cross-bores on the pistons are also bored on W. F. & John Barnes machines, and are ground on Heald internal grinders. Although all the Barnes machines illustrated are of the single-spindle type, a battery of four double-spindle machines has recently been installed for similar operations.

A Lees-Bradner thread milling machine is used for cutting the threads on pistons, orifice plugs, and packing gland cups, all to a Class 3 fit. In the operation shown in Fig. 17, an orifice plug of S A E 4130 chromium-molybdenum steel is being threaded externally. The thread is 2 1/2 inches in diameter, sixteen per inch. At the left on the front of the carriage is shown an aluminum-bronze piston in which an internal thread, 3 1/4 inches diameter, sixteen per inch, is milled.

A Warner & Swasey turret lathe tooled up for machining packing gland nuts from solid duralumin bars 5 3/4 inches in diameter is shown in Fig. 18. One finished nut is seen on top of the turret. In this operation, the stock is fed to a stop on the first turret face, after which a flat drill on the second turret face drills the piece to a conical seat. The flat drill is seen in the center of the illustration. The tools on the third turret face, at the left, next turn the end of the stock and bore it near the inner end of the drilled hole to a diameter somewhat smaller than that produced by the drill, so as to leave a flange on the piece when it is cut off.

A parting tool on the front of the cross-slide next cuts through the stock to within 0.010 inch of its center at the required distance from the front end to give the desired width to the finished piece. A slide tool on the fifth turret face cuts a recess near the back end of the large-diameter bore to provide clearance for a subsequent threading operation. The outside surface of the piece is next turned with a cutter on the front toolpost, and other cutters on the toolpost are used to round the front and back corners of the piece. Finally, the parting cutter on the toolpost completes the cutting off of the piece.

The partial cutting off is performed ahead of the finishing cuts so as to relieve the bar of all strains set up in the heavy boring and turning. If the complete parting were done at the end of all other cuts, the finished piece would be badly distorted.

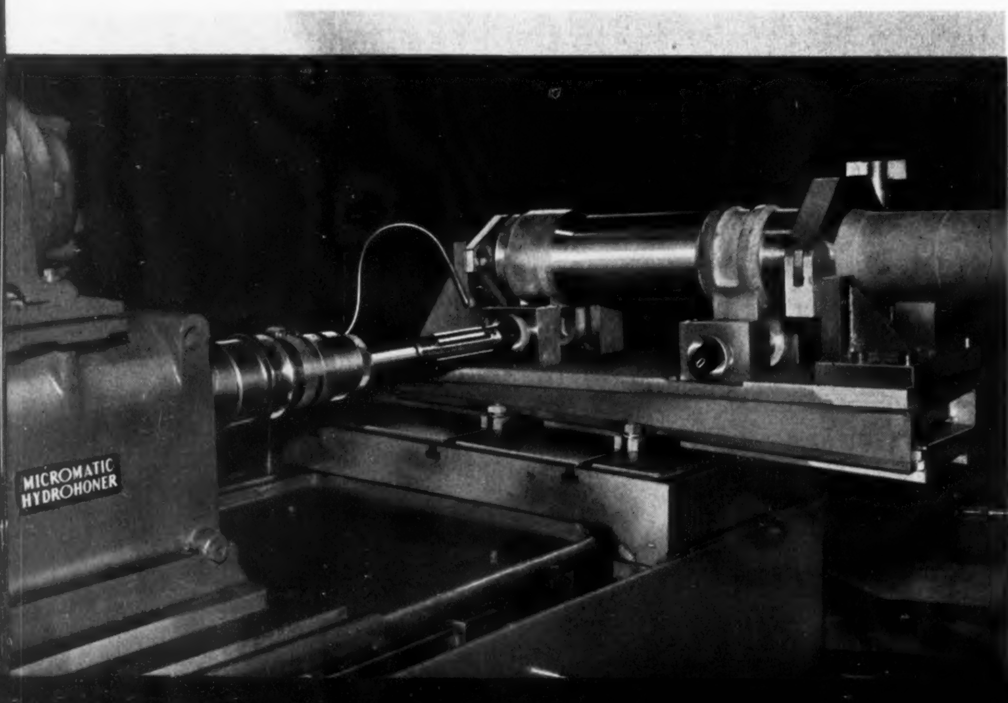


Fig. 15. Honing Lug Holes of a Main Strut, which are at Different Center Distances from Center of Strut, by Means of a Fixture of Angular Design

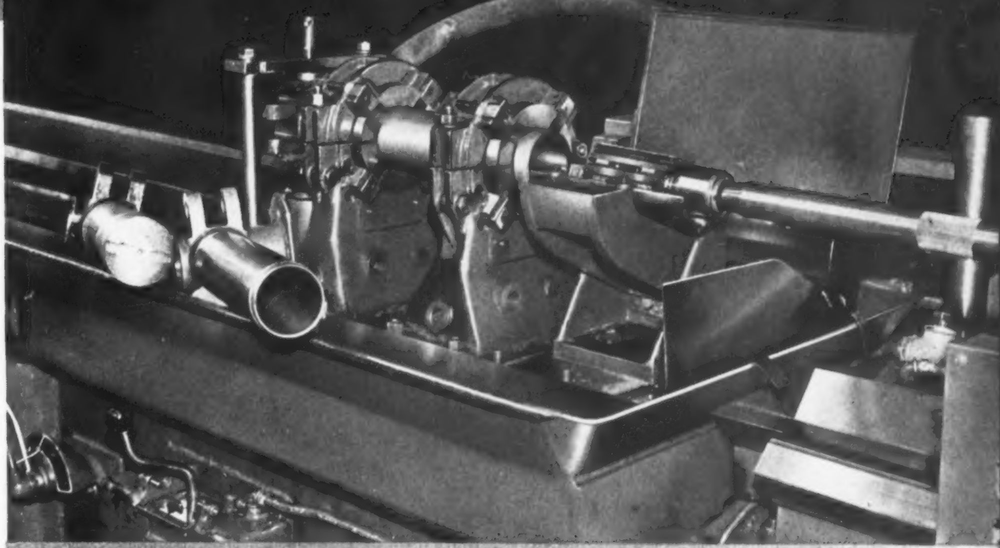


Fig. 16. Honing a Strut Piston on a Machine of the Hydraulic Type that is Used to Produce the Large-diameter Bore Completely from Solid Stock

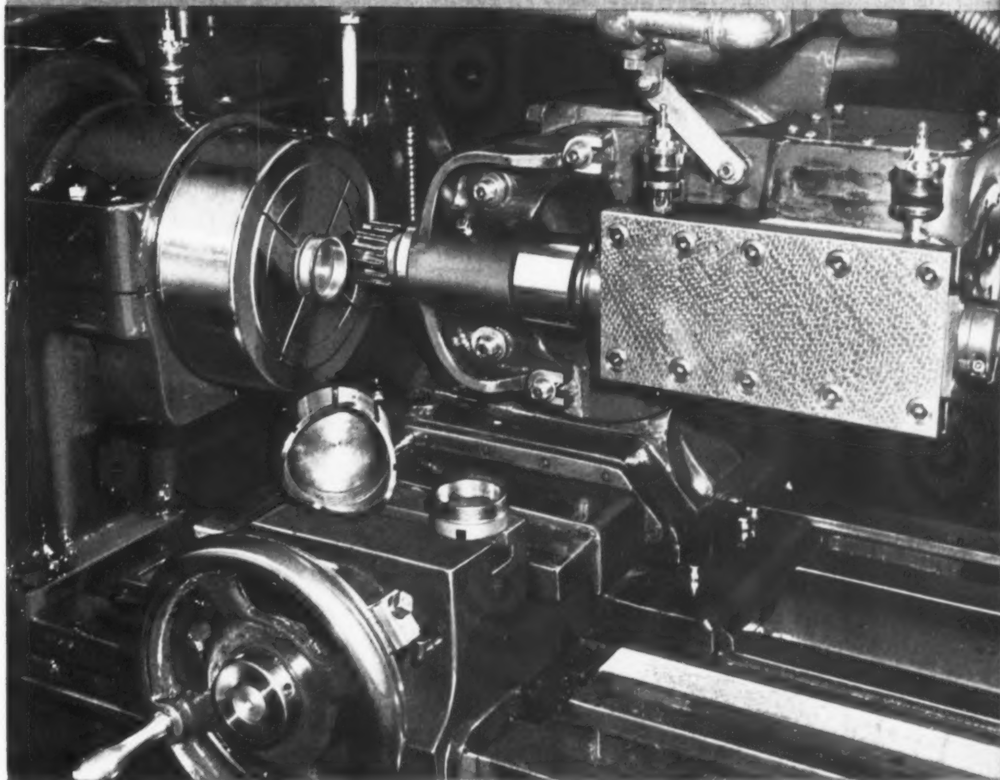
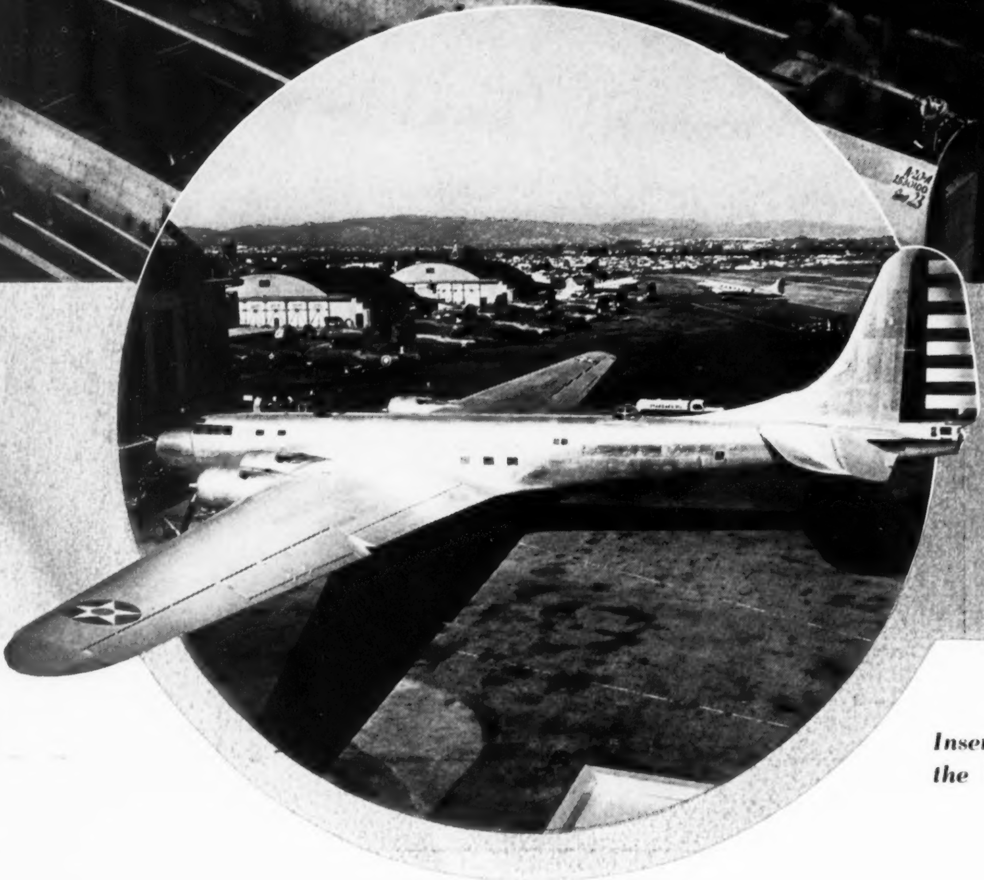


Fig. 17. Thread Milling Machine Producing Threads on an Orifice Plug to a Class 3 Fit as Required in All Aircraft Work

Fig. 18. Tooling Provided on a Turret Lathe that Produces Packing Gland Nuts Complete, Except for Threading, from Solid Duralumin Bars

DOUGLAS Tr[...] to Aircraft Pr[...]

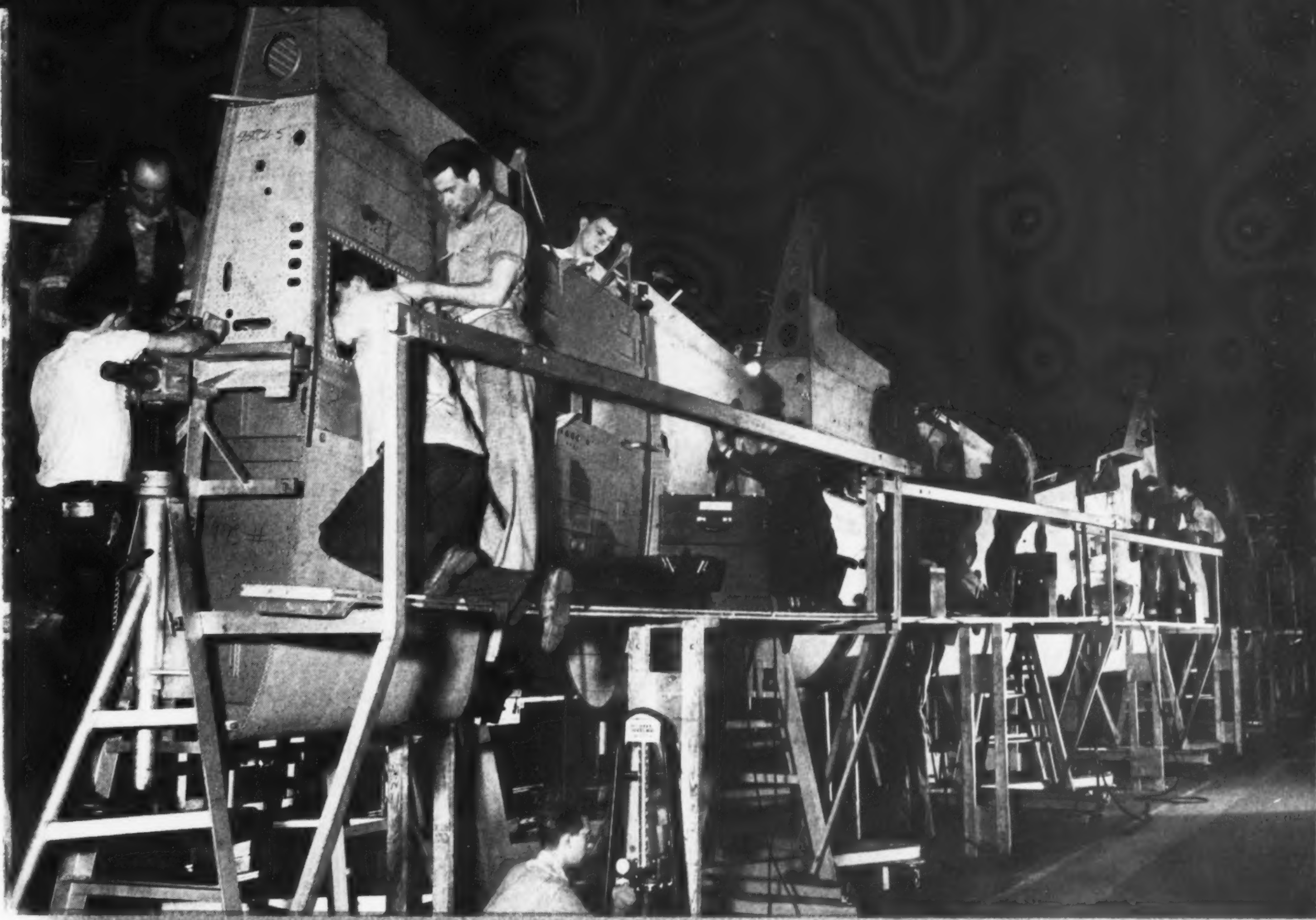


Insert Shows the Douglas B-19, the World's Largest Airplane

ONE of the most difficult problems that the engineers of airplane manufacturing plants have been called upon to solve is the attainment of quantity production in factories originally laid out and equipped for much smaller manufacturing schedules—in other words, how to build many planes where one was built before and how to do it in shorter time and for less money. This problem has been solved with great success in the main plant of the Douglas Aircraft Co. at Santa Monica, Calif. By the application of quantity production methods, the output has been increased approximately 200 per cent with an increase in the manufacturing floor space of only 20 per cent.

The required changes in the main plant have been going on simultaneously with the erection of a huge "black-out" factory at Long Beach, Calif., and another large assembly plant at Tulsa, Okla., and the expansion of the El Segundo, Calif., plant. The size of these plants may be judged from the fact that the Douglas concern will be employing more than 50,000 persons by the end of 1941.

The main plant at Santa Monica, which is the subject of this article, is now devoted almost entirely to the manufacture of twin-engine bombers for the United States and Great Britain. However, some standard DC-3 transports are also being built for military and commercial use. In planning the revision of this plant each department was studied as an individual unit and in its relation to the fac-



Translates Automotive Methods Practice

By H. E. GUERIN, Factory Manager
Douglas Aircraft Co., Santa Monica, Calif.

tory as a whole. Every effort was made toward simplified scheduling of operations and reduced handling of work.

Prior to this analysis of production, the factory was arranged on the principle of performing a given operation on all parts of the same design, regardless of the plane model, in one department. In other words, all spars were milled in one department, drilled in another, sub-assembled in a third, and so on. There were separate departments for each major airplane part. Work was transported from these departments to storage, back to other departments, again to storage, to sub-assembly jigs, and eventually to final assembly lines.

This procedure has been superseded by a straight-line technique under which all operations on a major unit are completed in one department and by machines and jigs set up in progressive sequence, so that storage for parts in progress has been eliminated completely. All operations on a wing, for example, are performed in one department and, therefore, under one supervision. The various plane units are delivered to the final assembly lines right from the major sub-assembly jigs. Before the plant was rearranged on the new basis there was 110 square feet of floor space for each employe. Now there is only 40 square feet, and the workmen actually have more space around machines and jigs in which to move about.

Operations at sub-assembly jigs and along the main assembly lines have been simplified by the delivery to each jig or assembly station of tote boxes that contain all the parts necessary for the operations to be performed at that point on one airplane unit. Trucks deliver these boxes from a central storage of fabricated parts to sub-assembly jigs before each shift goes on duty. Each man knows the amount of work that he is expected to do during his shift by the number of boxes on hand.

In this way, he is sure to keep the machine or jig that follows his supplied with work. Thus shortages are prevented and foremen can quickly spot any operations that are falling behind schedule. As the main function of a conveyor line is to estab-

Fig. 1. (Left) Hydraulic Table Equipment Installed on Both Sides of a Large Hydraulic Press to Keep the Press Constantly Supplied with Work

Fig. 2. (Below) Looking along the Wing Assembly Conveyor, Showing Manner of Suspending Wings from Dollies, and Groups of Assemblers in the Various Stations

lish timing, and as the size of an airplane, together with the present building construction limitations does not permit a moving conveyor on all subassembly work, every operation is timed, and a chart attached to each jig tells when it is to be unloaded. This provides a "clerical conveyor" which causes all work to move in an uninterrupted flow.

Visitors to the plant are impressed by the arrangement of the assembly lines and especially by the wing assembly conveyor, an overhead view of which is presented in Fig. 2. Each wing is suspended from dollies that run along overhead tracks, so that assemblers can work conveniently either on top or under a wing. The wings are moved intermittently from station to station along these tracks, which are approximately 500 feet long, the successive dollies being connected so that the entire

Fig. 3. (Right) View of Platens Shown in Fig. 1, with Left-hand Platen being Reloaded and Right-hand Platen in Line to be Moved under Press Ram

Fig. 4. (Below) Large Quantities of Work are Carried through the Anodizing, Washing, and Rinsing Tanks, and then to a Drying Oven by Means of an Electric Crane

line moves simultaneously. There are about forty positions or stations along the conveyor line, and at each station certain prescribed operations are performed by the men assigned to that station, as opposed to the method formerly in use when a wing was completely assembled in one position by one group of men. The station along the wing assembly conveyor at which the bullet-proof tanks are installed is shown in Fig. 6.

Under the new method each assembler repeatedly performs a limited number of operations, which has greatly expedited the training of new men to be assemblers. More important, however, is the fact that a reduction in wing assembly time of 70 per cent has been effected. When each wing reaches the end of this conveyor, it is ready for joining to a fuselage, which is simultaneously moved into position, ready for joining to the wing.

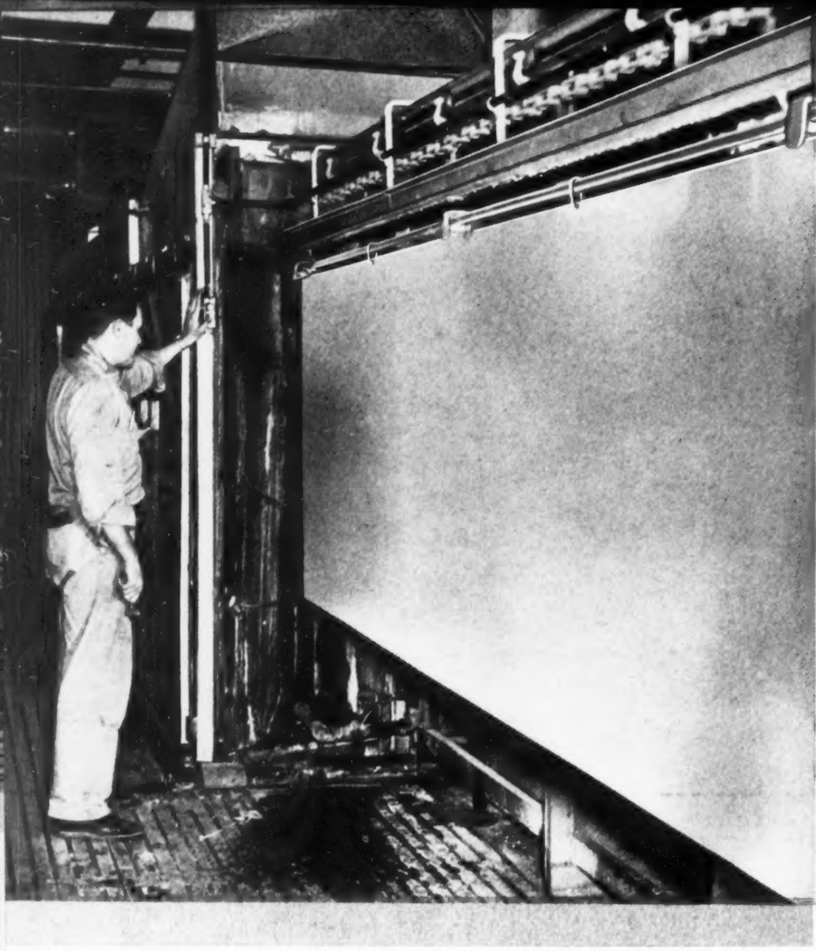


Fig. 5. Loading Station of Equipment Installed for the Acid Dipping, Rinsing, Drying, and Painting of Aluminum Alloy Sheets before Press Operations are Performed

Parts to be installed on the wings are supplied to the assemblers by special trucks, each truck being assigned to a particular station and containing all parts necessary to complete the individual installation. Nacelles are taken from their sub-assembly jigs, placed on dollies, and then moved along a straight-line assembly track which parallels the wing conveyor. Stops are provided on the nacelle track so that each particular operation can be repeatedly performed at the same point. When each nacelle is completed, it has reached the wing conveyor line at a point or at a station in which the wing is ready to receive the nacelle without further moving.

The heading illustration on page 162 shows a general view of the fuselage assemly line. The fuselages are fabricated at the extreme end of the assembly line in a battery of jigs, so arranged that the half fuselages can be removed in the proper sequence, then mounted in pairs on dollies, which proceed down the assembly line on tracks provided with stops so that the proper installations can be made in a predetermined sequence. After painting and sub-installations, the half fuselages are drawn together and joined. After further installations, the fuselages reach the end of the wing track, ready to receive the wing without loss of movement, the wing being conveyed by an overhead monorail and dropped on the fuselage.

Further down the line, the airplanes are ready for the installation of the engines, which, in turn, are fed to the proper station by means of a sub-assembly track that parallels the main assembly line and operates in a similar manner. All installations are sub-assembled in a location adjacent to the position in which they are to be installed in the main assembly line. The planes continue to move down the track in a straight line until they reach the assembly hangar. They are then divided and sent alternately down tracks which run along opposite sides of the building. Planes on one side receive the insignia of the United States Army Air

Fig. 6. Station along Wing Assembly Conveyor in which the Bullet-proof Gasoline Tanks are Installed

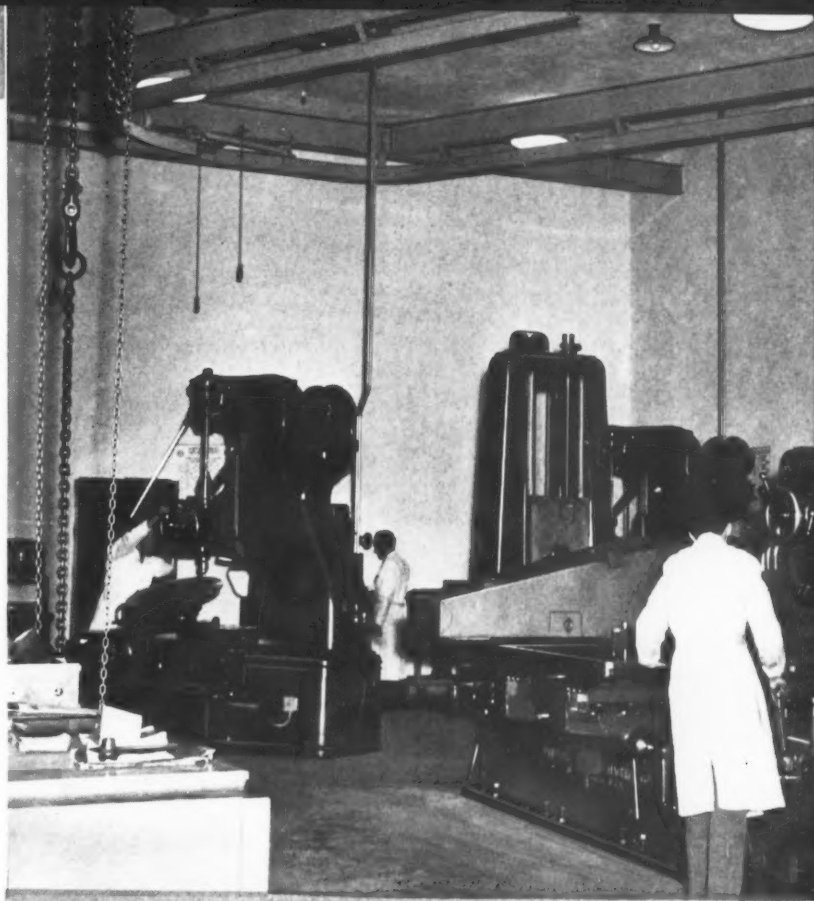


Fig. 7. One Corner of an Air-conditioned Room which Turns out Master Gages, Highly Accurate Jigs, and Similar Equipment for All the Douglas Plants

Corps, and those on the other side, the identifying marks of the British Royal Air Force. Planes are lined up at an angle to the walls of the building, as it was found that, in this position, sixteen could be placed in a row extending the length of the building, whereas only eight planes could be lined up with the wings at right angles to the side walls.

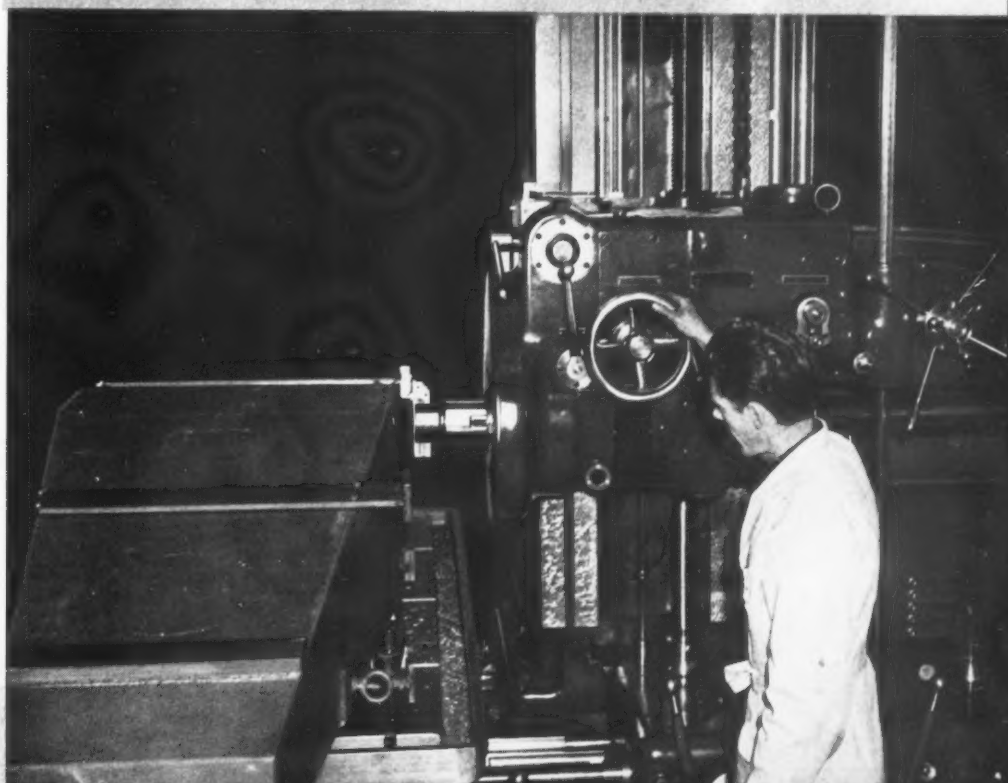
Sheet-metal forming operations on an HPM hydraulic press of 5000 tons capacity have recently been speeded up by the provision of hydraulic table equipment, which is arranged for feeding platens of work automatically into position beneath the press ram as quickly as they can be reloaded by four crews of men. Two crews are located on opposite sides of the hydraulic table equipment at each end of the machine.

When a platen has been loaded with work, it is pushed sidewise by hydraulic power into line with the center of the press, and is then pushed endwise, also by hydraulic power, into position beneath the ram. At the end of the operation, the platen is returned in the reverse procedure to be reloaded by its crew. At the same time, another platen is placed beneath the ram from the opposite side of the press. This cycle is repeated constantly, with the result that the press is in practically continuous operation.

In Fig. 1 is shown the hydraulic table equipment that is installed on the left-hand side of the press. One of the platens has just been pushed from under the press ram, and in the next operation of the hydraulic table equipment, will be pushed to the left to its crew of men for reloading. The platen seen at the right has been loaded with forms, blanks of sheet metal, and rubber blankets, ready to be pushed into line with the press ram and under the ram when the platen being operated upon is returned to its starting position.

In Fig. 3 the platen seen in line with the press ram in Fig. 1 has been moved to its crew and is being reloaded, while the one seen at the right in Fig. 1 has been lined up with the press ram. The

Fig. 8. Operation Performed by a Horizontal Boring Mill on a Wing Master Gage 11 Feet in Length



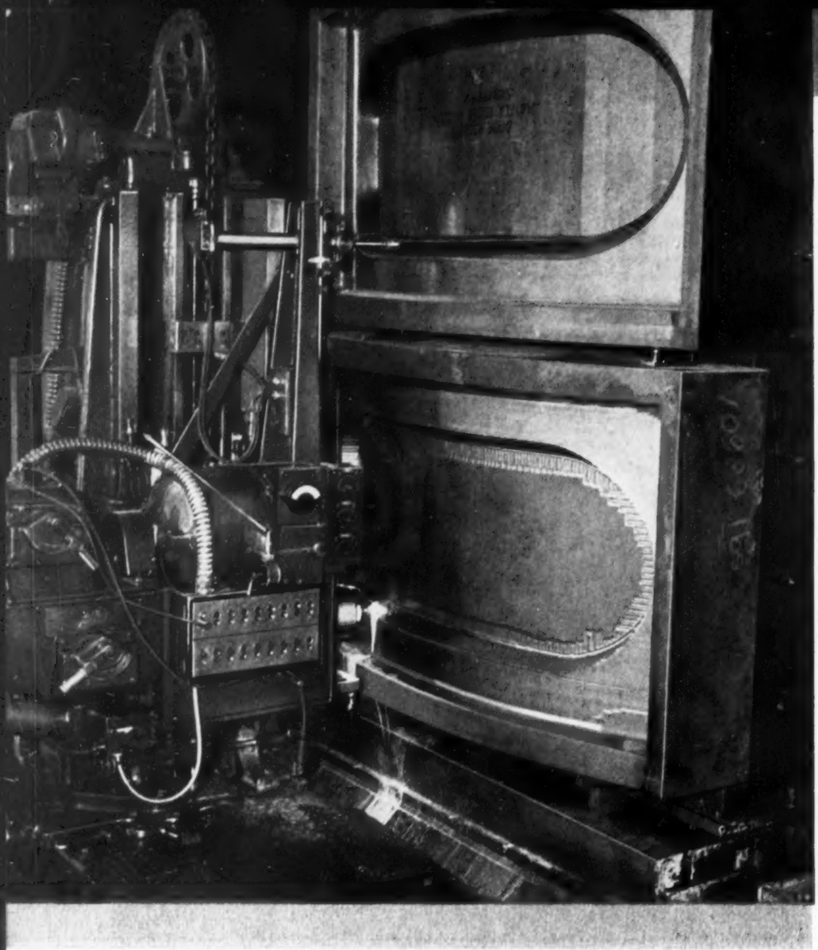


Fig. 9. Machining a Large Die Required for the Forming of Airplane Doors on a Kellermatic Tool-room Machine

transfer of all platens is always under the control of the press operator and one man of each crew. The platens are 14 feet long by 4 feet wide.

Before any work is done on the sheets of aluminum alloy which are used in such large quantities in aircraft manufacture, the sheets must be given an acid dip, rinsed in water, dried, and painted. When these operations were performed by hand, the total time per sheet amounted to 18 minutes. Through the use of recently installed automatic equipment, the loading station of which is seen in Fig. 5, all of these operations are now performed at the rate of 200 sheets an hour. The sheets are automatically pressure-sprayed with acid and water rinsed, after which they are passed progressively to drying, automatic painting, and drying compartments. The sheets are 12 feet long by 5 feet wide.

The general view of the anodizing department in Fig. 4 shows the application of an electric push-button controlled crane for carrying quantities of work simultaneously through the several stages of the process. By means of the crane, the work is transferred from the anodic tank to washing and rinsing tanks, and then to a drying oven. The anodic tank has capacity for 8000 gallons.

A new department of the plant that is pointed to with considerable pride is an air-conditioned machine shop which produces gages, jigs, master parts, and high-grade tooling for all Douglas factories. This room, one corner of which is shown in Fig. 7, is maintained at a temperature of 70 degrees F. the year round. This insures that precision parts will be machined under ideal conditions, and that they can be rechecked from time to time at the same temperature as that under which they were originally made. Trane 5-ton air-conditioning equipment supplies 5000 cubic feet of air per minute, the air being 50 per cent recirculated. A chain hoist of 7 1/2 tons capacity is provided on overhead tracks to facilitate loading and unloading heavy castings and forgings.

In Fig. 8 and in the foreground of Fig. 7 is

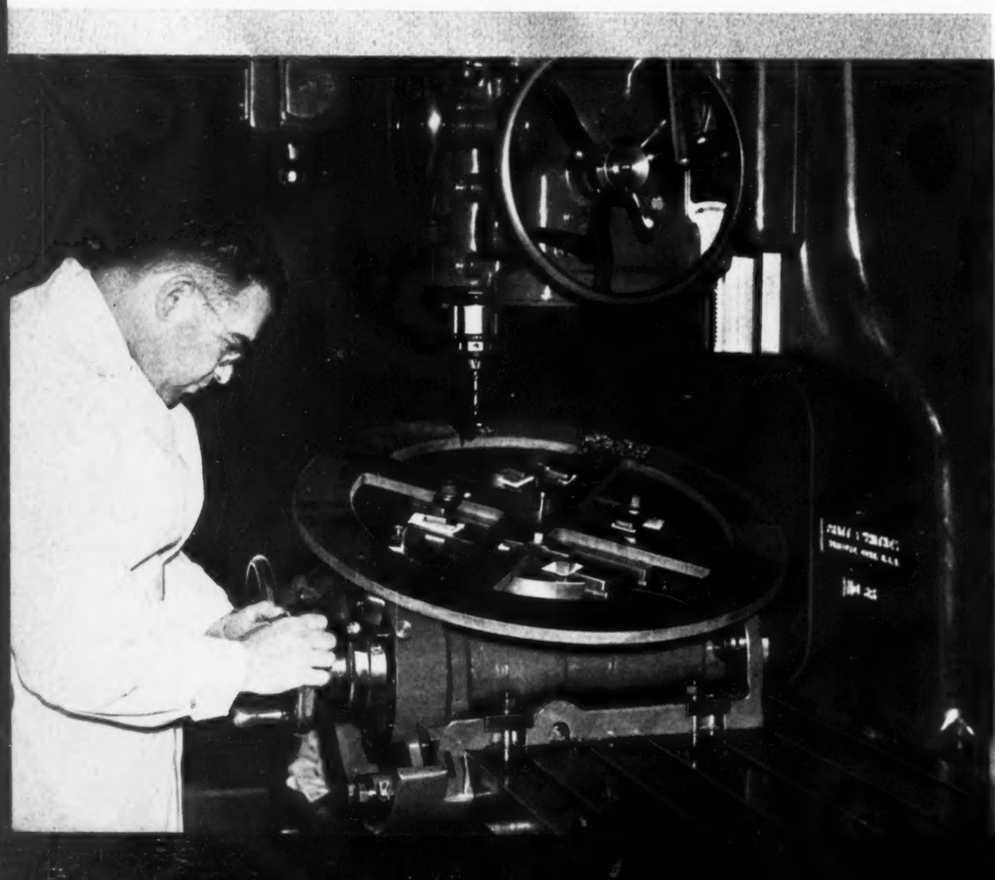


Fig. 10. Employing a Jig Boring Machine for the Accurate Drilling and Boring of Thirty-two Holes around a Ring that is to be Cut into Segments

Fig. 11. Employing a Sheet-metal Shrinker to Eliminate the Wrinkled Edges on Parts Formed under Hydraulic Presses

shown a Universal horizontal boring, drilling, and milling machine being used to accurately face several feet on a large wing master gage of welded-steel construction. A fly cutter is employed for taking the facing cuts. The master gage is later bored on the same machine. On operations like this, dimensions are customarily held to within 0.001 inch as to center distances. The master gage shown is 11 feet long.

A close-up view of one of the Pratt & Whitney jig boring machines in this room is shown in Fig. 10. The operation consists of drilling and boring thirty-two holes around a ring that is later to be cut into eight segments for use on nacelle jigs. The radial location of the various holes had to be correct within 1/2 degree, and the hole diameters had to be within plus 0.0000 inch minus 0.0005 inch of the specified dimensions.

A large die-block for forming airplane doors is seen being machined in Fig. 9 from a wooden master above the work by a Kellermatic tool-room machine. The die-block measures 8 feet long by 3 feet wide.

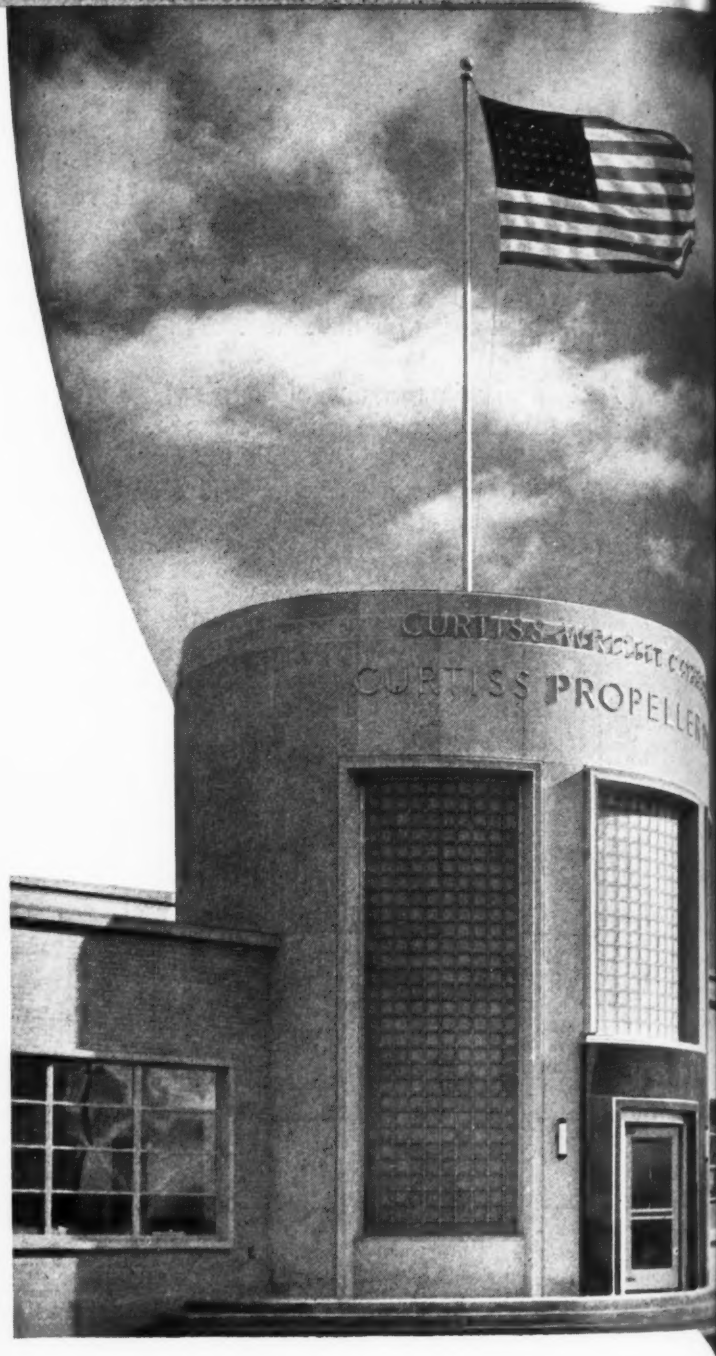
One of several Autometric jig boring machines is shown in Fig. 12 being employed for drilling and boring a series of holes in a jig plate. The tool-head is positioned at an angle on its circular table to present the horizontal tool-spindle correctly to the work. The vertical work-table can be indexed about a complete circle, and can be raised or lowered on the machine column to obtain various heights with respect to the cutter-spindle.

Many small parts formed under hydraulic presses from sheet aluminum alloy have wrinkled edges, as seen on some of the examples lying on the table in Fig. 11. These wrinkles are eliminated by means of the Erco sheet-metal shrinker seen in the illustration, which is equipped with two sets of jaws for gripping both sides of the wrinkled sections. After the gripping action has taken place, the jaws are moved sidewise, which causes a reduction in the area of the metal gripped and an increase in its thickness, thus eliminating wrinkles.

Fig. 12. Performing a Series of Accurate Drilling and Boring Steps on a Small Jig Plate by the Use of an Autometric Jig Boring Machine

Steel Propeller Blades from One of

By RALPH J. SCHNEIDER
Factory Manager, Propeller Division
Curtiss-Wright Corporation



A PHENOMENAL expansion of manufacturing facilities has been accomplished by the Curtiss-Wright Corporation during the last three years. In July, 1938, this corporation operated plants with a total floor space of 1,637,780 square feet and an employment of 9138 persons. Three years later it had under way an expansion program that called for the operation of plants with a floor space of 10,581,300 square feet and 71,500 employes.

Back in July, 1938, the Curtiss Propeller Division employed only 111 employes and occupied a floor space of 17,000 square feet. Today this division operates five plants with a total floor space of 1,415,000 square feet, and employs approximately 5000 persons. Within a year it expects to employ 15,000 persons. Last year the headquarters of the Propeller Division were moved to a new plant at Caldwell, N. J., which is one of the most modern in the entire aircraft industry. Some of the unusual methods used in that plant for manufacturing hollow steel-blade propellers will be described in this article.

The principal advantage claimed for steel propeller blades is that their high surface hardness makes them particularly resistant to erosion. They are lighter in weight and possess greater strength than duralumin blades, and are not so easily damaged by striking objects. The exterior surfaces

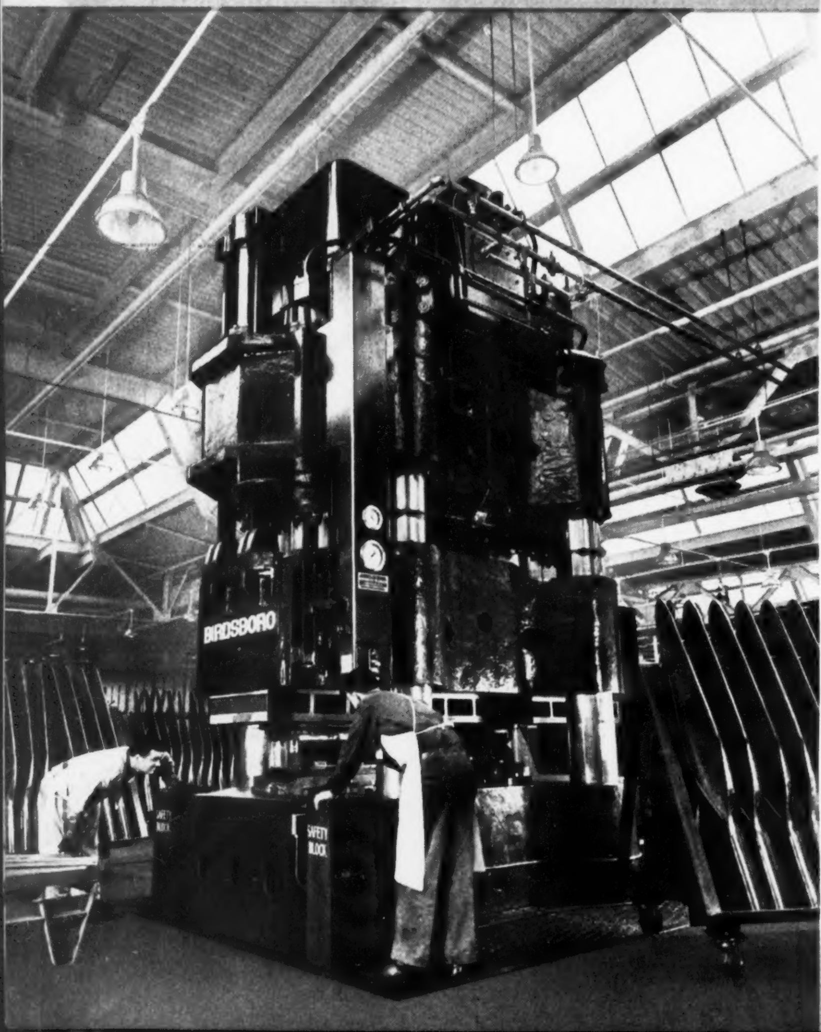
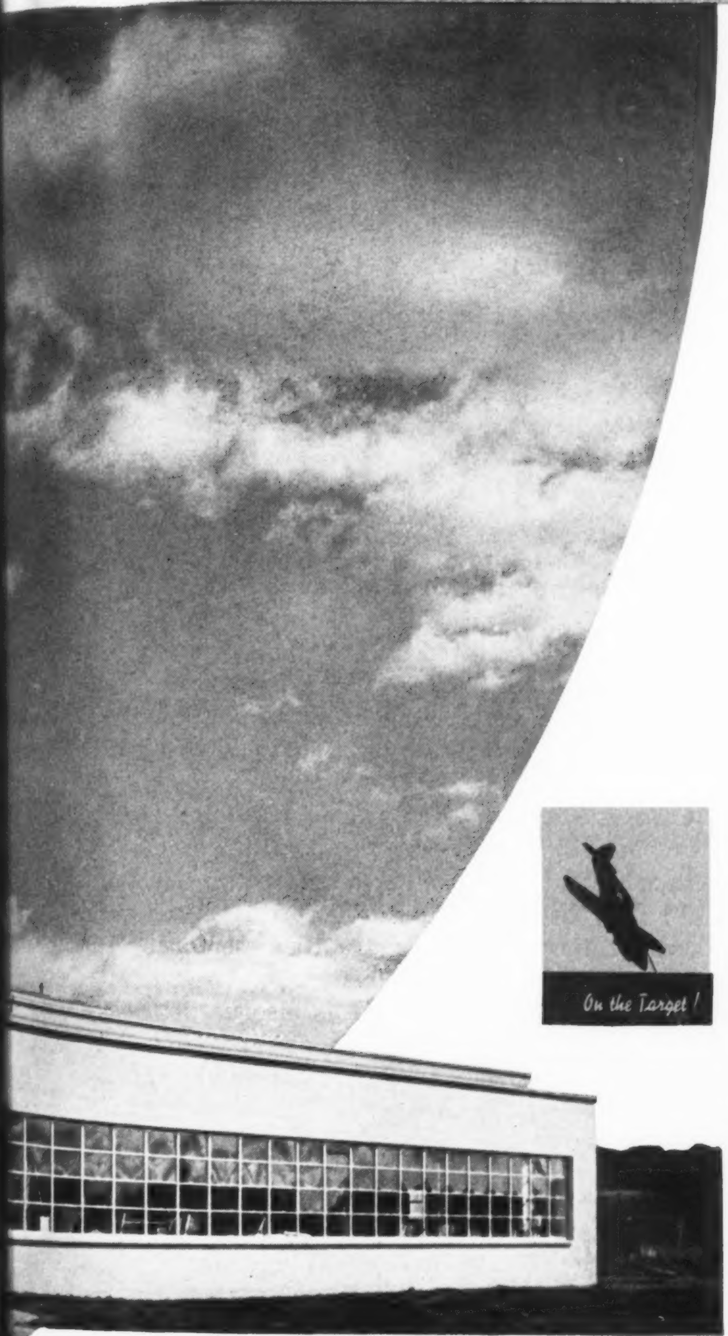


Fig. 1. Two Thousand Ton Hydraulic Press that Blanks and Forms the Camber and Thrust Plates for Hollow Steel Propeller Blades

CURTISS-WRIGHT'S New Plants



are finished with a heavy plating of dull chromium that protects them against oxidation, cuts down sun glare, and greatly reduces the likelihood of nicks, scars and stone bruises.

The methods used in manufacturing hollow steel propeller blades differ substantially from those employed in producing aluminum blades, due principally to the difference in the construction of the blades and to the difference in the materials. The chromium-vanadium steel plate from which the blades are made is received from the steel mill in blanks of approximately the width, length, and thickness required for the thrust and camber sides of the blades. Before the plates are machined, they are checked for dimensions, analyzed metallurgically, and tested for hardness. Each plate is stamped with the heat number of the steel, the serial number, and a symbol that identifies the type of blade to be produced from it.

The plates are then sent to a Cincinnati Hydromatic milling machine equipped as shown in Fig. 3 for holding a quantity of plates at an angle while the edges are being milled. Both edges are finished in this manner to establish the desired width and produce angular surfaces of 30 degrees to facilitate clamping in subsequent operations. Ten camber plates, or thirteen thrust plates, are generally placed in a fixture at one time. The camber plates are 5 1/2 feet long, and the thrust plates considerably shorter.

The steel plates are next passed on to other milling machines for slab-milling one side. Each plate is held securely to the fixture by clamps arranged along both sides. A cut the full width of the plates is taken by 6-inch cutters.

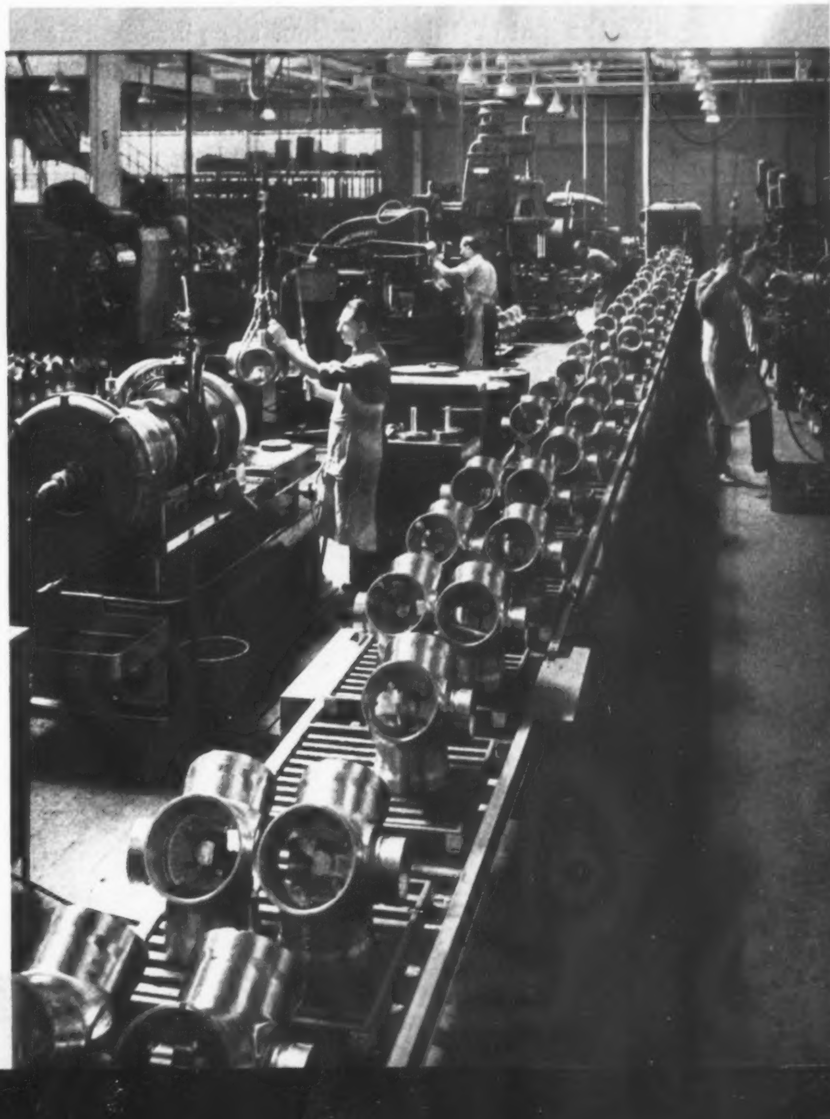


Fig. 2. Manufacturing Propeller Hubs by Mass Production Methods in One of the New Curtiss-Wright Plants

Fig. 3. The First Machining Operation in the Manufacture of Steel Propeller Blades Consists of Edge-milling the Camber and Thrust Plates

The next operation consists of "breaking down" the camber plates crosswise a foot or so from one end to enable stock to be milled from the major portion of the plate without cutting away the metal required for forming a shank. This bending operation is performed on a Birdsboro 300-ton hydraulic press equipped with a simple set of dies.

After another milling operation, the camber plates go to the 2000-ton Birdsboro press illustrated in Fig. 1, which bends the lengthwise edges of the plates downward to start forming the camber. They are then returned to a milling machine for milling to a varying width along the center. At the end of this operation, the plate is finished to its final thickness, except for an allowance for finish-grinding.

The camber plates are now returned to the 2000-ton hydraulic press to be blanked out to the desired outline, different dies from those used in bending having been substituted. In blanking, short pieces are sheared from the scrap for test purposes. These pieces are heat-treated according to specifications, then machined into test specimens, and checked to determine their physical characteristics.

Complete forming of the camber plates is then performed in a series of press operations, starting with a preliminary forming operation on the shank end under the 300-ton hydraulic press. Second and third forming operations are then performed on the main portion of the blade under the 2000-ton press, after which this press is also used to close the stock of the shank end into a cylindrical shape.

Manufacturing procedure for the smaller thrust plate which is later welded to one side of the cam-

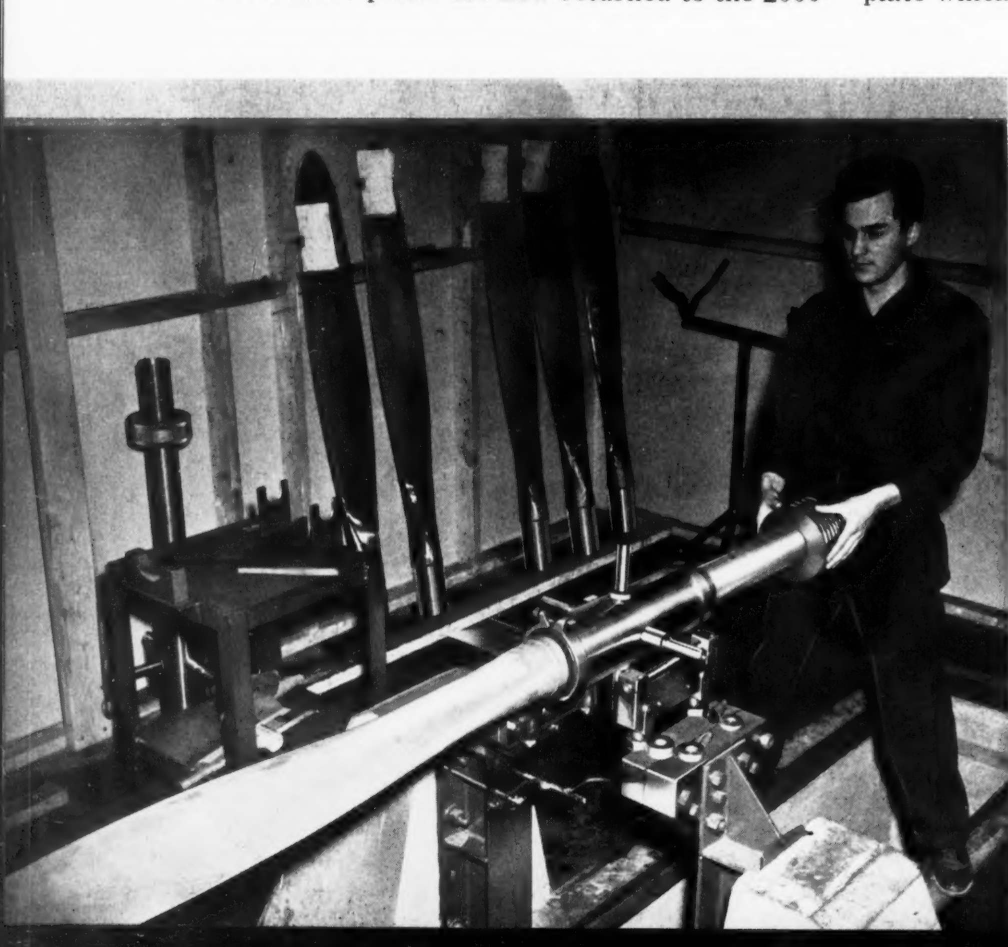


Fig. 4. Checking a Propeller Blade for Balance by the Use of a "Dummy" that has been Calibrated with Respect to a Master Blade

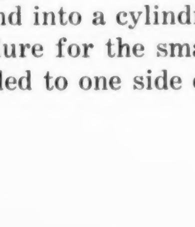
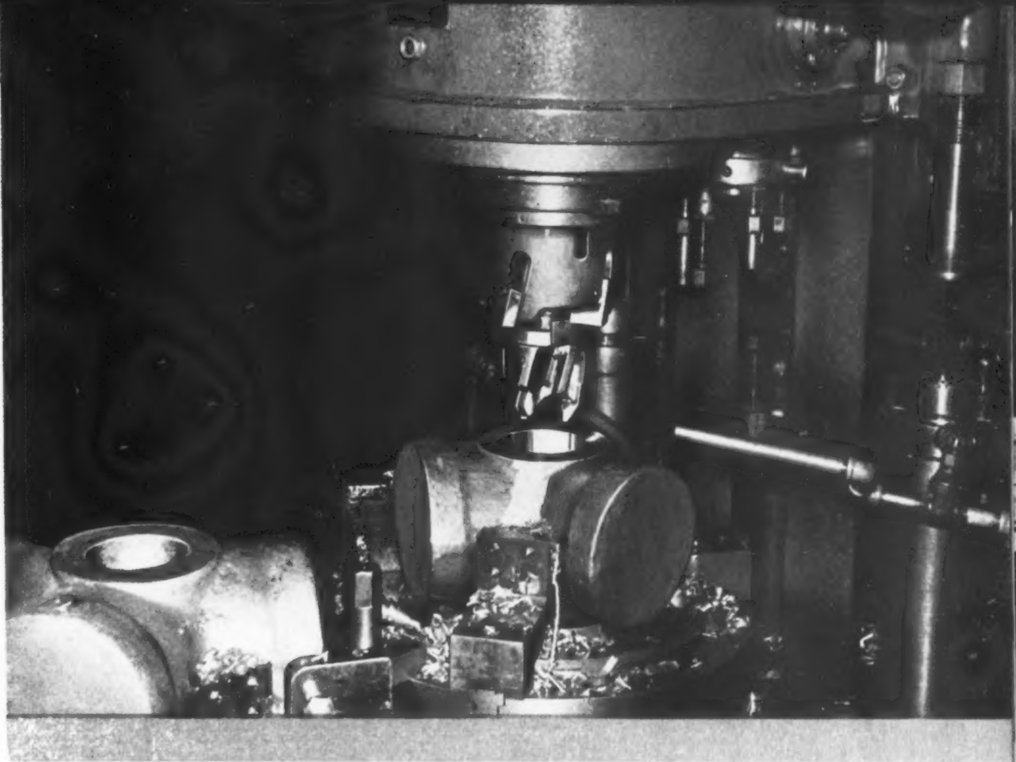


Fig. 5. Drilling, Boring, and Facing of the Propeller Hub Forgings are Performed on This Hydraulically Actuated Vertical Type of Machine



ber plate to form the complete hollow blade is similar to that described in the foregoing, except that some of the operations, such as those performed on the shank end, are unnecessary.

The camber and thrust plates are next welded together. For this operation, the camber plate is placed in a fixture and the thrust plate placed on top of it. Clamps operated by large handwheels are then tightened on top of the two pieces to hold them securely. A hand-manipulated welding torch is now moved along the trough where the edges of the two pieces join, so as to completely fill the trough with weld metal. The joint where the two edges of the shank end meet is similarly welded.

The inside of the seam at the shank end is then welded while the propeller blade is held in a gas-heated oven, after which the blade is taken to the National forging machine shown in Fig. 7, where the top cavity of a die insures roundness of the formed shank. A shot-blasting operation is next performed to remove scale from the inside of the propeller blade and from the shank end. The propeller blade is then again taken to the National forging machine for an upsetting operation, which is performed with the shank placed successively in the three bottom die cavities.

After another shot-blasting operation, there follows a series of hot-straightening, rough-turning, normalizing, and other detail operations. Boring, turning, and grinding cuts are taken on the shank end in an engine lathe. The boring and turning tools are held on a compound rest, and a grinding attachment is mounted at the rear of the cross-slide. The various diameters must be concentric at

Fig. 6. One of a Series of Grinding and Polishing Operations Performed in Finishing Steel Propeller Blades to Their Required Contour

Fig. 7. The Shank End is Closely Rounded and also Upset in Operations Performed by This Forging Machine

the completion of this operation within a tolerance of 0.0002 inch.

A balancing operation is next performed to establish the true center line of the propeller blade. This is done on the stand seen in Fig. 4, with the blade shank inserted in a holder that has a weighted bar on the opposite end which serves as a dummy blade. This dummy has previously been calibrated in accordance with a master blade. When the blades are too light, type metal is added, and when they are too heavy, additional stock is merely removed.

The method of determining the balance is extremely sensitive. The blowing of a man's breath on the blade will cause it to revolve on the test fixture. After being polished, the blades are again checked for balance, and the assembled propellers are given a final balance before shipment for assembling into planes.

At the end of the preliminary balancing operation, the propeller blades are passed to thread milling machines for hobbing the internal threads in the shank end. This operation must be performed to an extremely close tolerance with respect to the start of the thread and the concentricity of the thread with the ground external surface of the shank.

Final finishing of the blades is performed in a series of operations on stands provided with flexible-shaft equipment. Snagging wheels and sanding disks are employed to remove scratches and polish. Finally a Tampico brush is applied. Fig. 6 shows a polisher engaged in rounding the edges of a blade to contours corresponding with those seen on the templet at the left. The blades next go to the plating department for the application of a hard gray

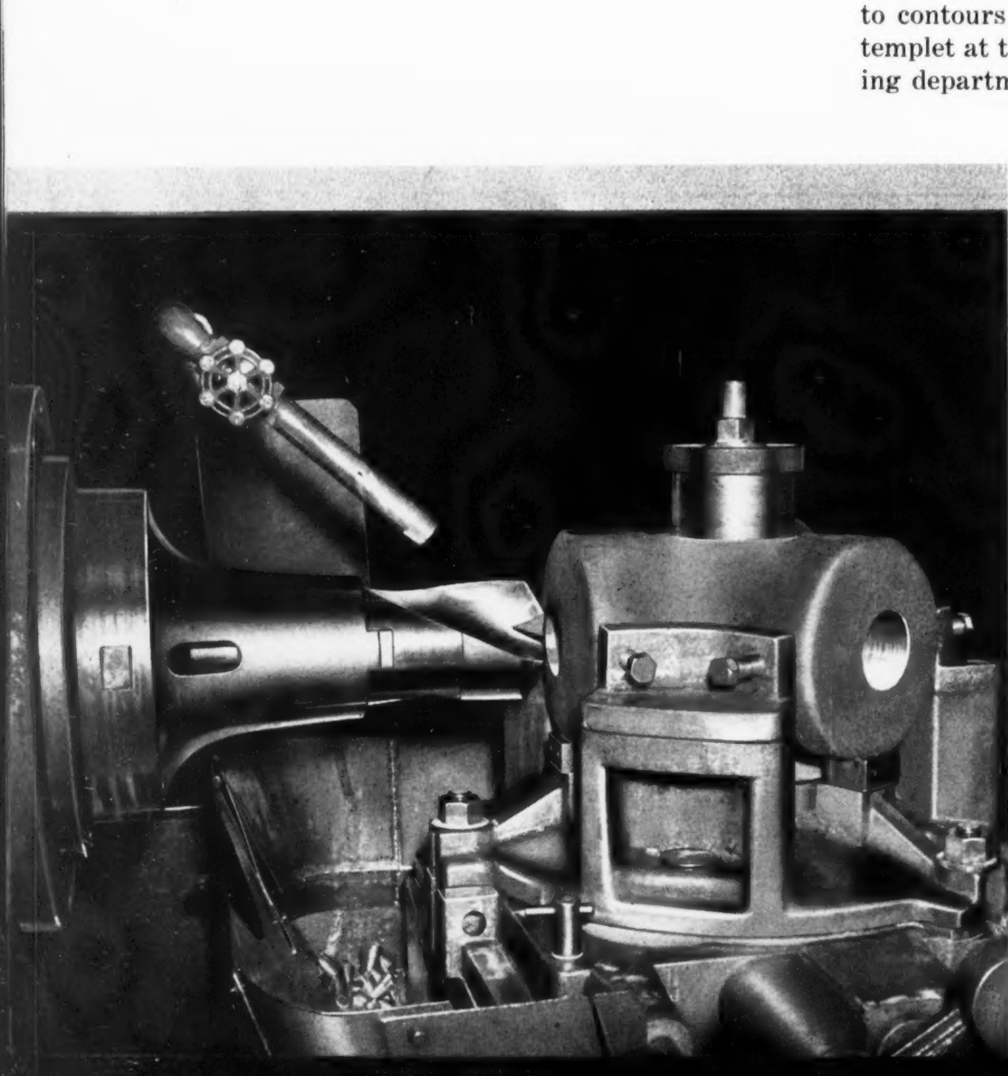


Fig. 8. A Drill 5 Inches in Diameter being Used for the Second Operation on the Bore in Hub Barrels

chromium finish. They are then subjected to another balancing operation before being assembled to the hub units.

Many unusual operations are also performed in machining the propeller hubs. The hub forgings weigh 275 or 375 pounds in the rough, depending upon their type, and only 57 pounds, within plus or minus 2 pounds, when completely finished. This represents a stock removal of 79 and 85 per cent on the two different types.

The first operation on the hub forgings consists of drilling and boring the cross-bore on the Baker vertical hydraulically operated machine shown in Fig. 5. The cross-bore is produced from the solid, except for a shallow depression in each side of the forging. The first step consists of drilling a 3 5/16-inch hole completely through the cross-bore, which is accomplished with two vertical movements of the drill. Then with a change of tools, rough-boring, rough-facing, and step-boring cuts are taken in sequence. Equalizing chucks are provided on the fixture to insure that the top of the hubs will always be at the same level, despite differences in the length of the forgings. Two chucks mounted on an indexing table provide for reloading while operations are in progress.

Each time the fixture is indexed, four clamps are swung upward on opposite sides to lock it securely to the table. Indexing is accomplished manually, being facilitated by the provision of a ball in the center of the fixture, which raises it for the duration of the indexing movement. With this provision, the fixture can be swung around by a light finger pressure. When the tools are released from the spindle of the machine, they drop on a wooden block that has been placed over the work.

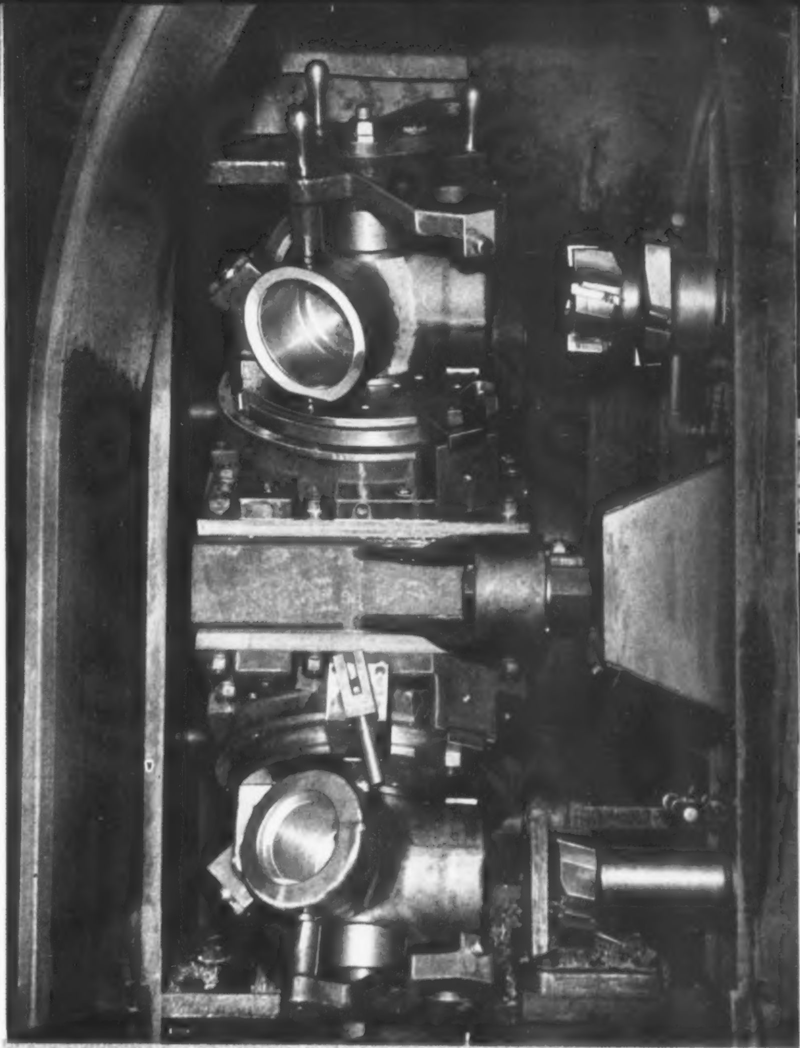


Fig. 9. Drum Fixture and Tooling Used in Performing Three Operations on Three Hub Barrels with Nine Indexings of the Fixture

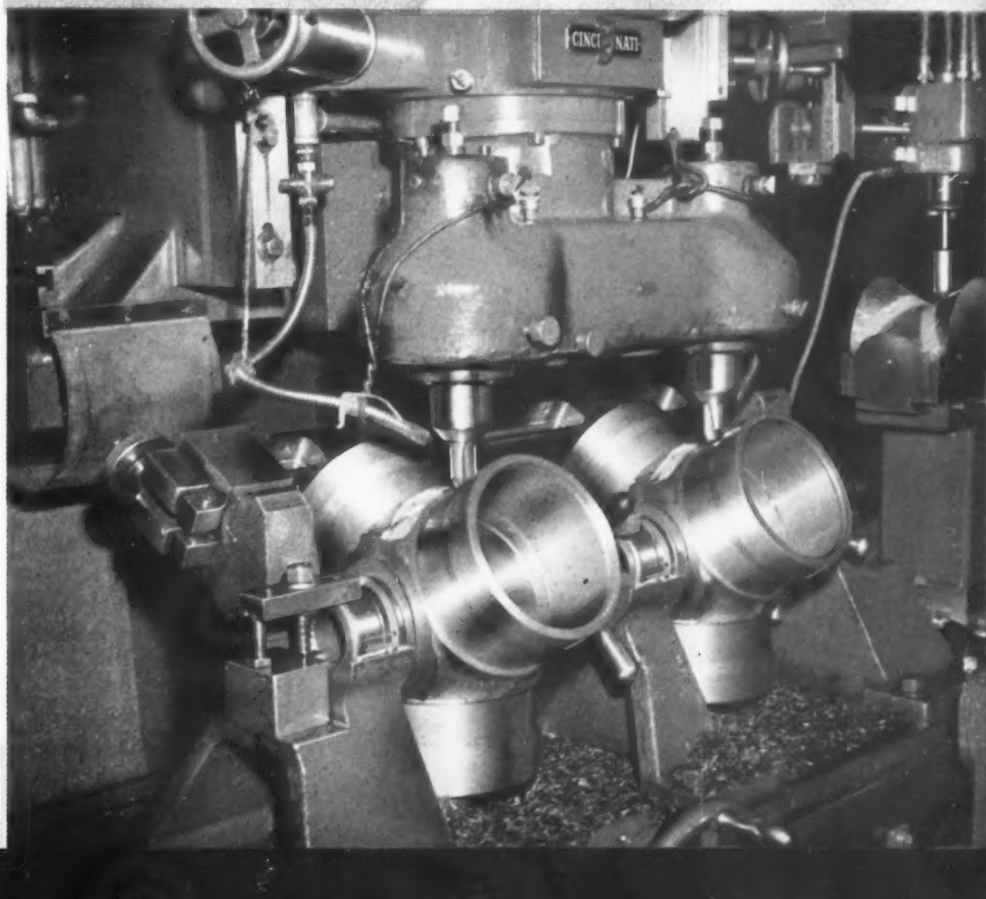


Fig. 10. Hydrotel Milling Machine Removing the Excess Stock between the Barrels of Hub Forgings

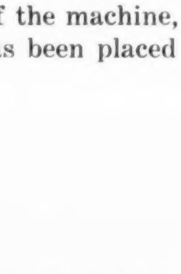


Fig. 11. Broaching Large-Diameter Splines through the Cross-bore of a Hub Forging on a Horizontal Pull Type Machine

The propeller hubs next go to two Potter & Johnston automatic chucking and turning machines, which take a large number of cuts on both ends. In the first of these operations, cuts are taken on the extension end, the hub being held by the three jaws of an air-operated chuck that grip the forging between the barrels. In this operation, rough- and finish-boring cuts are taken on the cross-bore, and a conical seat is rough-bored. The extension end is also turned by an overhanging tool on the turret, and faced by tools on the cross-slide. Tungsten-carbide tools are used on all internal surfaces, and Stellite cutters on external surfaces. Similar cuts are taken by the second automatic on the opposite side of the forging.

The next important operation on the hub forgings is performed by the Baker horizontal drilling machine shown in Fig. 8. This machine is equipped with a hydraulic mechanism for rapidly traversing and then feeding the drill to the work. Two machines of this type are employed on each forging, the first machine being used for drilling a 3 5/16-inch hole through each barrel to the cross-bore, and the second for enlarging the hole to a diameter of 5 inches. The illustration shows the second machine. The machines are equipped with indexing fixtures which provide for aligning all three barrels with the drill. For both operations, the previously machined cross-bore is seated on a vertical arbor.

Three successive operations are next performed on all three barrels—a total of nine operations—by the Natco three-spindle machine illustrated in Fig. 9. This machine is equipped with a three-station drum which carries the hubs around a horizontal shaft to the three working stations, one barrel only of all three forgings being operated upon during a single cycle. When each hub returns to the first station, it is indexed through 120 degrees

Fig. 12. Grinding a Conical Seat in the Cross-bore of a Hub Forging on a Chucking Grinder

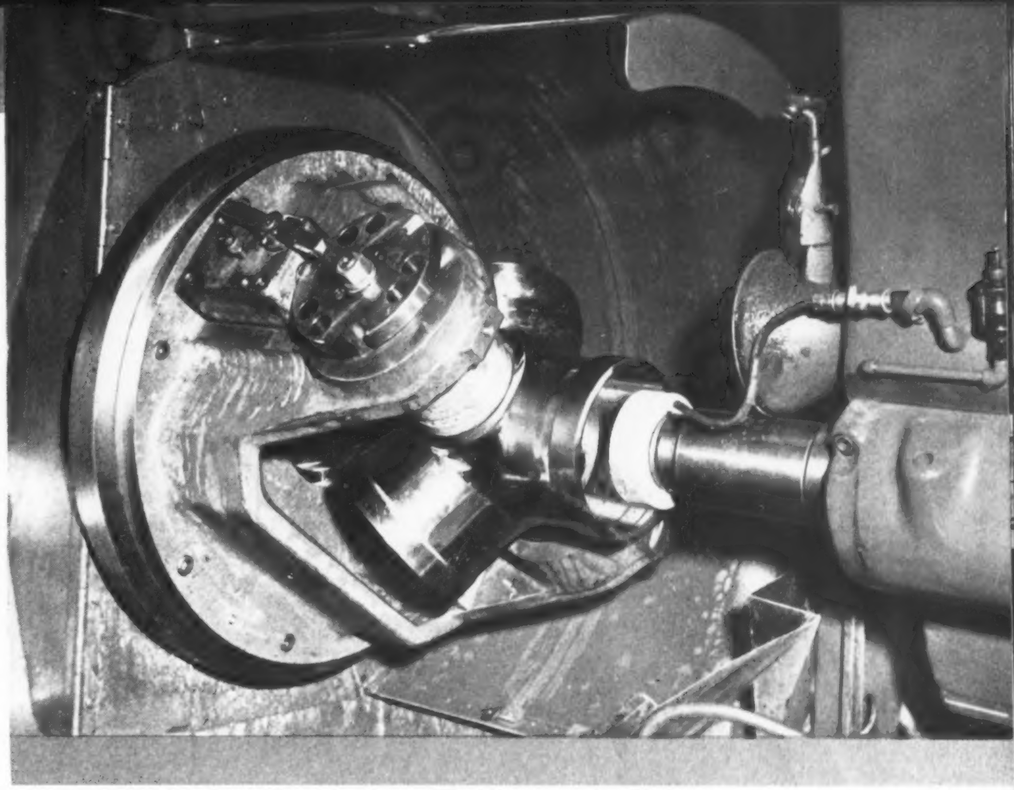


Fig. 13. Another Chucking Grinder with an Indexing Fixture for Grinding the Three Barrels of the Hub Forging at One Set-up

to bring the second barrel toward the tool-spindle for the next cycle. At the end of the second cycle, the hub is again indexed for machining the third barrel. One hub is finished in every three machine cycles.

The operation consists of boring the barrels to a diameter of about 7 inches, and forming a contour at the bottom of each barrel. Indexing of the fixture drum is accomplished mechanically, but the individual fixtures are indexed manually. The tool-head of the machine is operated hydraulically.

A Cincinnati Hydrotel milling machine is employed for removing excess stock from the external surfaces that join the barrels, as seen in Fig. 10. Two propeller hubs are placed in the fixture at one time, and routing cutters are guided over the contour to be machined under the control of a tracer which rides on a master mounted on the right-hand end of the table. This tracer is operated in two planes, vertical and horizontal, and imparts similar movements to the two cutters. The propeller hubs are mounted on arbors, and are located by a plug on a bar at the rear of the fixture. By indexing the hubs, the excess stock can be milled from between all three barrels.

Washing, heat-treating, and Magnaflux inspection then follow, the propeller hubs being hardened to between Rockwell 28 and 32 on the C scale. After this sequence of operations, the propeller hubs go to two Potter & Johnston automatics, which take finishing cuts on the cross-bore preparatory to broaching the splines. The broaching operation is performed on a Lapointe horizontal pull type machine, as illustrated in Fig. 11. The splines are broached to a root diameter of 3 9/16 inches by rough and finish broaches, 66 inches long.

Finally, a series of grinding operations is performed on the cross and barrel bores by a battery of Bryant chucking grinders. Fig. 12 shows one of the machines employed for grinding two conical seats at opposite ends of the cross-bore in line and concentric within 0.002 inch. The conical seat in one end is ground to an angle of 15 degrees, while the seat in the opposite end is finished to an angle of 30 degrees. One seat is ground in a lot of propeller hubs, and then the set-up is changed for grinding the other conical seat in the same lot.

Fig. 13 shows one of the chucking grinders employed for finishing the barrel bores. The indexing fixture provides for grinding all three barrels at one set-up of the work. Limits of plus 0.0008 inch, minus 0.0003 inch are maintained.

On the Target!

VULTEE Increases Plane

Production Tenfold

By C. A. SHARPE
Superintendent, Vultee Field Division
Vultee Aircraft, Inc.

WHEN President Roosevelt, in May, 1940, called upon the aircraft industry for a tremendous expansion in manufacturing facilities, Vultee Aircraft, Inc., immediately developed a plan for enlarging its capacity that has now been completed. In less than twelve months, the manufacturing floor area was increased from 326,000 square feet to 1,795,000 square feet. It is now almost six times greater than when the government announced the airplane building program. Production in 1941 is expected to be ten times what it was in 1940.

Vultee expansion was expedited by the purchase of factories at Nashville, Tenn., and Wayne, Mich., in addition to materially increasing the manufacturing space of the main plant at Vultee Field, Calif. Manufacturing facilities are being devoted this year to the production of basic trainers, pursuit planes, dive bombers, observation planes, and small private planes.

Factory expansion these days is not alone a matter of erecting buildings, buying production equipment, training personnel, and lining up machines to insure a steady flow of work to assembly lines, but also of tooling up machines in a way that will insure satisfactory work in sufficient quantities from machines operated largely by men not necessarily of a "specialist" class. Typical tooling provided on presses and machine tools in the Vultee Field factory will be described in this article.

Hydraulic press operation has been expedited by the use of presses built with three supporting columns and provided with a circular work-table that indexes about one of the columns to carry platens of work successively to the press ram. The heading illustration shows a Birdsboro 2400-ton press constructed and equipped in this manner. The indexing table is 10 feet in diameter, and is provided with three platens, 45 inches square. Each platen is located automatically under the press ram.

This press is used entirely for drawing and forming operations. Forms made of Masonite, Zamak, and steel are placed in multiple numbers on the platens, and blanks of sheet metal on top of the forms, by the two loaders seen at the right in Fig. 2. The blanks are shaped to the forms by heavy blankets of rubber attached to the press ram. Pieces are drawn to depths as great as 2 inches. The sides of parts are bent down in some cases as much as 4 1/2 inches, but in such operations, it is not necessary to push the rubber the full depth of the bent sides. The men seen at the left in the illustration remove the finished work.

Most of the work formed by this press is made from sheet aluminum alloy, but a considerable number of stainless-steel parts are also formed, and even some simple pieces from sheet lead. In Fig. 2, one of the men at the left is seen lifting a "dished" part from a form. Immediately to his right is a lead piece that was formed into a half-round tube from a flat sheet about 1/4 inch thick. In operation, the press ram makes a fast descent to the work, a slow downward movement for the actual forming operation, and a quick return.

Mechanical presses are employed for many drawing and forming operations, increased production schedules having warranted the adoption of methods similar to those applied in automobile plants. Production from the mechanical presses is much greater than when the various operations were performed under rope type drop-hammers. The punches and dies used on the mechanical presses are made from Meehanite and steel, in addition to Zamak.

A typical operation performed on a Minster 150-ton press is illustrated in Fig. 1. At the left is shown a part for an exhaust collector ring, which is produced from a stainless-steel blank cut out and punched to the shape illustrated at the right. This piece is drawn completely in one movement of the

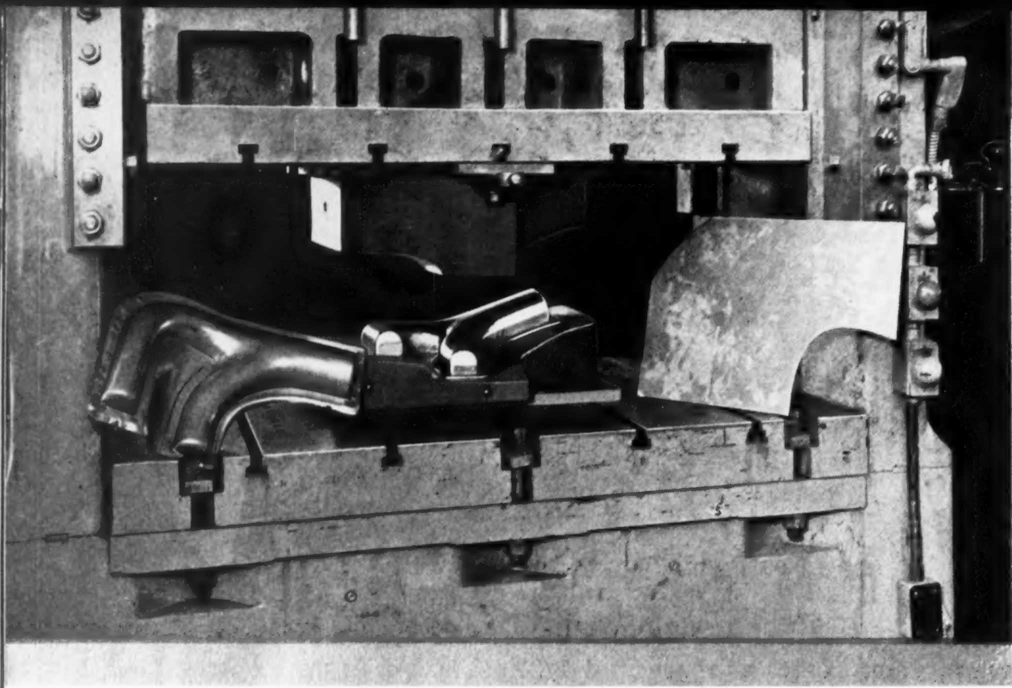


Fig. 1. Power Press Provided with Meehanite Punch, Die, and Blank-holder for Drawing a Complicated Part from Stainless Steel

punch, the maximum draw being about 1 1/2 inches. The sheet metal is held firmly against the face of the punch by a blank-holder, which completely surrounds the die; the blank-holder is shown in its bottom position in the illustration. This blank-holder is normally held up in line with the top of the die by an air cylinder in the base of the press which holds a series of pins against the bottom of the blank-holder. In this way, the air cylinder applies a pressure of several tons on the blank-holder. The die, punch, and blank-holder are all made from Meehanite.

Another 150-ton Minster press is shown in Fig. 3 equipped with a punch and die for bending down two edges on long curved blanks of duralumin. Blanks of the material may be seen lying on the right-hand end of the press bolster, and a finished piece at the left. The die equipment is designed for forming two pieces at a time.

In an operation, two blanks are laid on vertically moving members of the die, which are normally held flush with the top of the die, as seen in the illustration. When the punch descends, these movable members are forced down into the die, the edges of the work being bent upward. The movable die members are provided with three dowel-pins each, for locating the blanks from punched holes. They strip the work from the die cavities when the press ram moves up at the end of an operation.

A Minster press of 350-ton rating, with a working area of 60 by 90 inches, which was installed in the sheet-metal shop too recently to be illustrated here, is being employed for drawing operations on considerably larger work. One of the operations consists of forming nose cowls to a radius of approximately 2 1/2 feet and to a rounded cross-section. Dies for performing both these operations are mounted on the press at one time. One of the dies is of the cam-operated type commonly found in automotive stamping shops. It is made with a

Fig. 2. The Feeding of Work to the Ram of Hydraulic Presses in the Vultee Plant is Facilitated by the Use of Indexing Tables

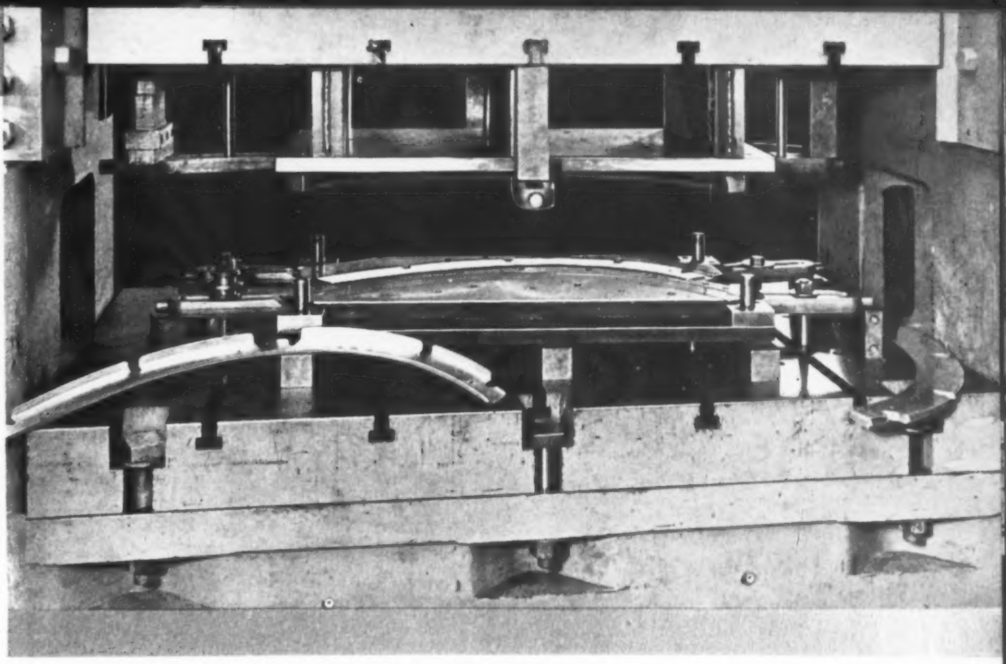


Fig. 3. Press Equipped with a Double Die for Forming Curved Edges along the Sides of Two Duralumin Pieces Simultaneously

member that moves horizontally to "tuck under" the cowl on one side as the press ram descends. Both these forming operations are performed without subsequent heat-treatment, which was required with the production method that was previously employed.

Square dish-shaped stampings of duralumin are being produced on a Bliss 100-ton press with the die equipment shown in Fig. 4. These stampings are later cut into four pieces to obtain corners for gasoline tanks. They are 7 inches square, and are drawn to a depth of 1 3/4 inches. The punch and die are made of Zamak, and the blank-holder of steel. More than 1500 pieces had been drawn at the time the photograph was taken, and the punch and die were apparently in as good condition as when the operation was first started.

A multiple riveting operation that has been speeded up by the use of a feed dial is illustrated in Fig. 5. This operation is performed on a special machine constructed with a Chicago Pneumatic compression riveter which actuates a vertical slide to which a riveting head is attached. The operation consists of riveting together two flat rings and a retainer which holds a series of buttons. Eight rivet heads are squeezed at one time.

The two men seen at the right load the pieces to be assembled on spring-suspended disks in six stations of the indexing table. Each station is automatically stopped beneath the heading slide, where the parts are gradually pushed down by the riveting head against the action of the springs that support the dial plates. The man at the left is kept busy removing the assembled units.

In many operations on Erco automatic punching and riveting machines, templets are attached to the work so that the operator can quickly determine the locations in which holes are to be punched and rivets headed. In the typical operation shown in Fig. 8, a templet is seen on the lower side of a long

Fig. 4. Production Operation on a Power Press in which Square Dish-shaped Pieces are Produced from Aluminum Alloy Sheets

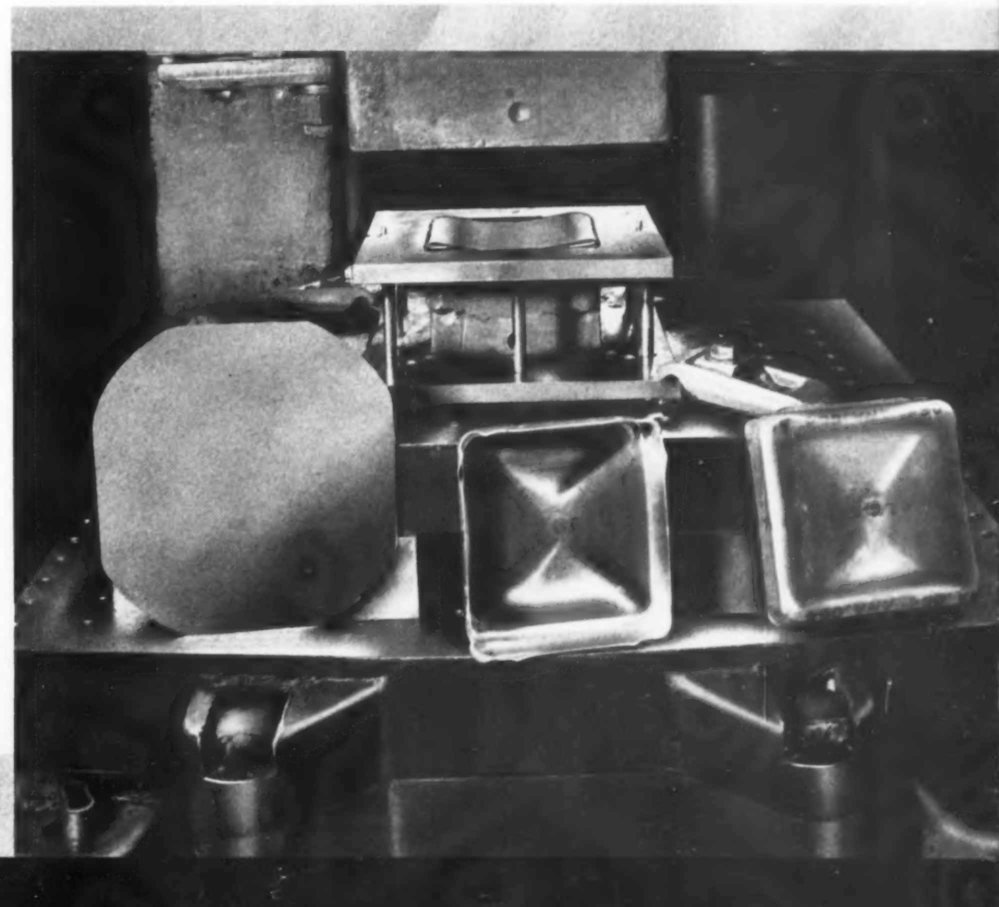


Fig. 5. (Left) Multiple Riveting Operation that has been Speeded up by the Provision of an Indexing Work-carrying Dial

Fig. 6. (Below Left) Bending Operation on a Hydraulic Press in which the Halves of the Split Die Swing Outward

Fig. 7. (Below Right) The Use of Jigs and Multiple-spindle Machines has Speeded up Many Drilling Operations

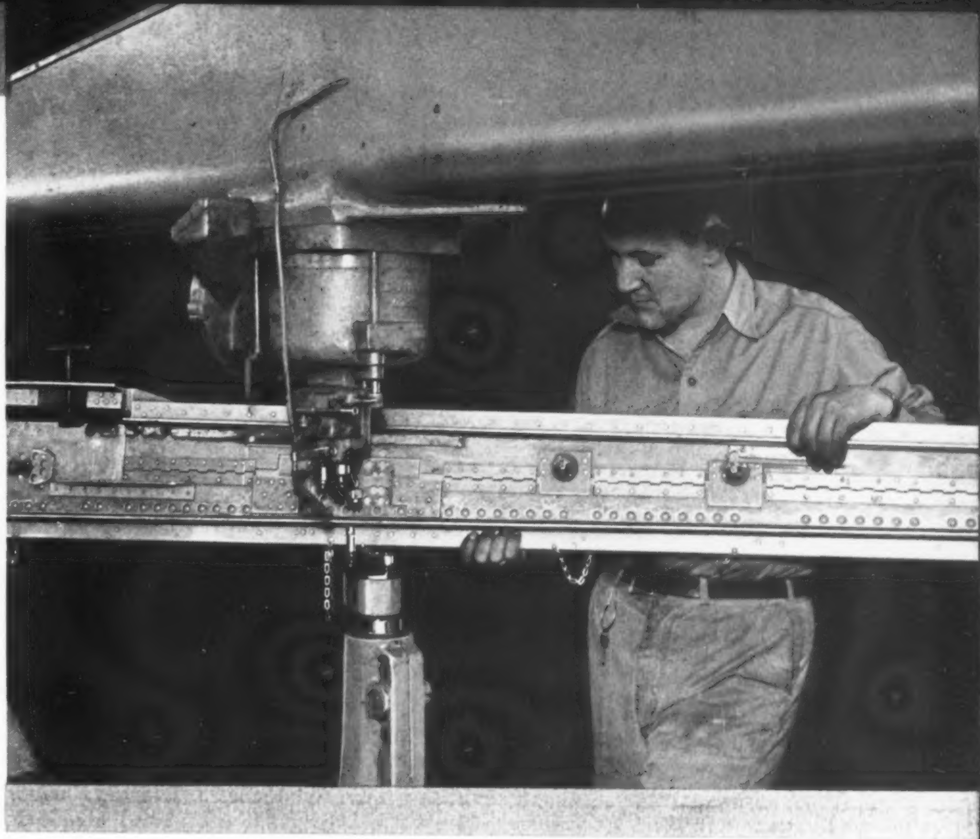
spar. In punching and riveting, the operator merely slips the templet from hole to hole over the nose of the stripper on the machine. This is done entirely by "feel," as the operator cannot see the templet holes, due to the fact that they are on the under side of the assembly.

A Lake Erie hydraulic press of 66 tons capacity is shown in Fig. 6 being used for a bending operation on a piece of extruded aluminum alloy that serves as a cap for an upper-section beam. The press is equipped with a die that is split vertically in the center for its full width. Each die half is pivoted at its upper outer corner, and two thick rubber pads are provided beneath the die halves. When pressure is applied on top of the work by the curved block attached to the lower end of the press ram, the two die halves swivel on their pivots against the action of the rubber pads, enabling the

Fig. 8. (Right) Templets Secured to the Under Side of Parts to be Assembled Facilitate Automatic Punching and Riveting

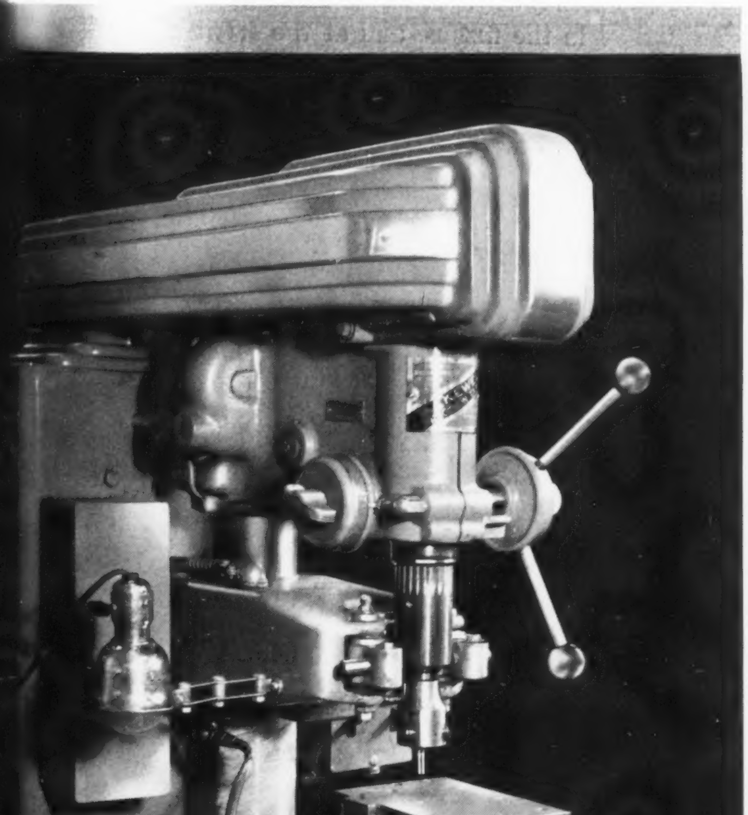
Fig. 9. (Below Left) Precision Tapping Operation in which an Irregular-shaped Part is Readily Handled by a Simple Jig

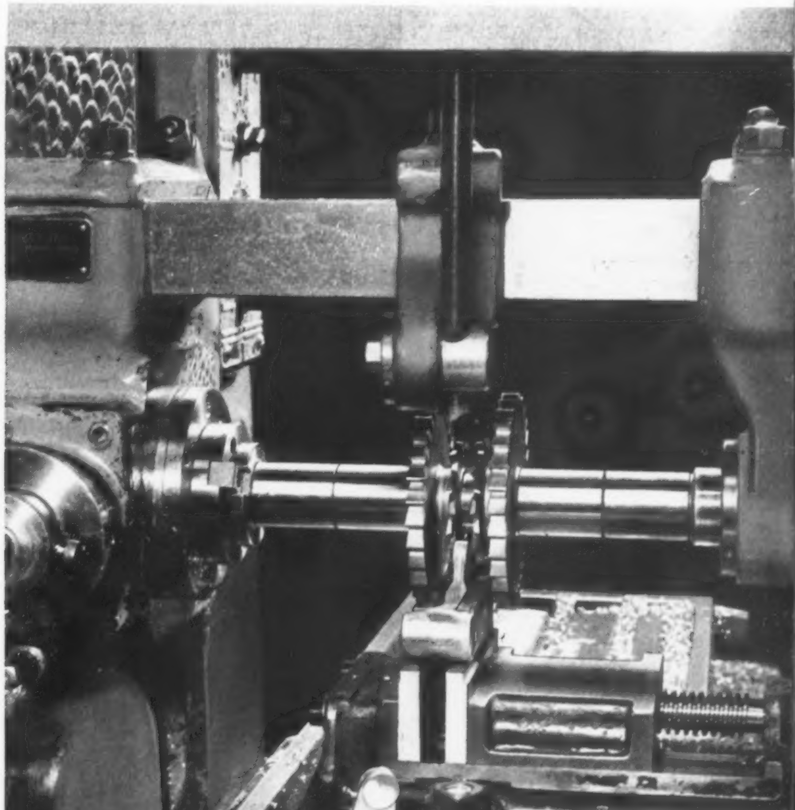
Fig. 10. (Below Right) Lugs of Different Lengths on Ends of Aluminum Forgings are Straddle-milled by Four Cutters on One Spindle



work to be bent to the desired shape without the formation of wrinkles.

Machine shop operations have been speeded up by the provision of jigs, fixtures, multiple tooling, etc. Fig. 7 shows a typical multiple drilling operation on a Natco machine, constructed with a table that is raised almost instantly into the drilling position by compressed air and then fed upward slowly for the operation by means of a hydraulic system. The operation consists of drilling twelve holes on each side of an aluminum forging, the group of drills at the left being used on one side, and the cluster of drills at the right on the opposite side. An adjacent machine of the same type drills nine holes in the bottom of the forging while it is clamped in the same jig. In each operation, an automatic cycle of the machine is started by depressing a foot-pedal.





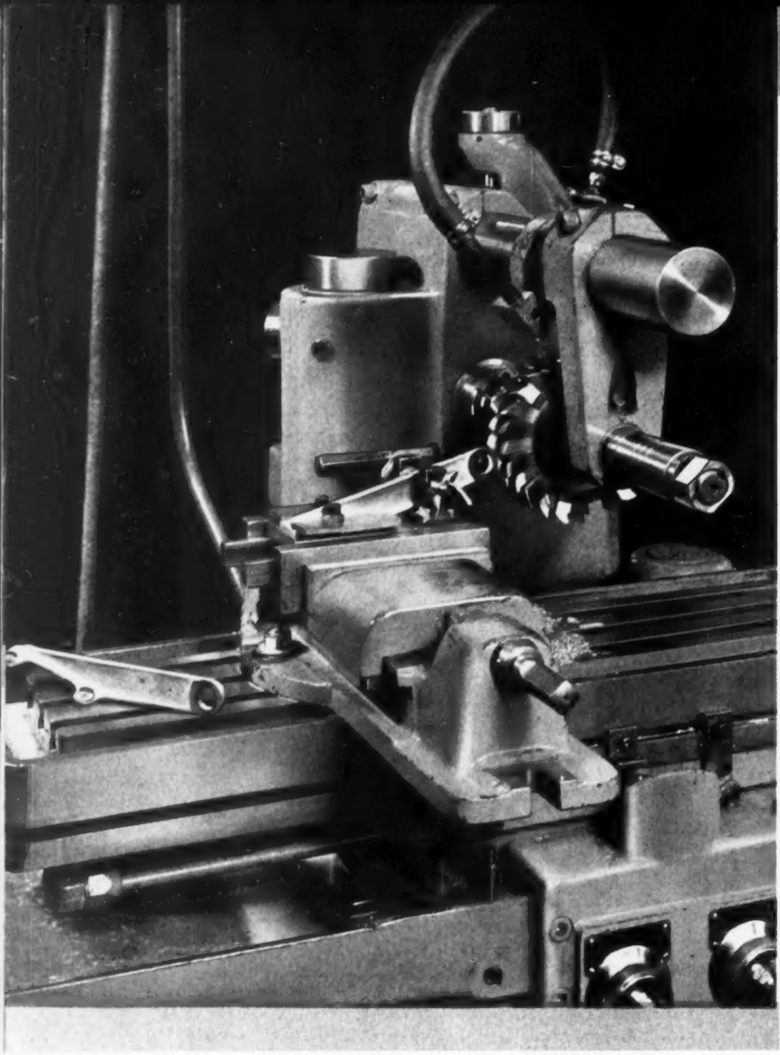


Fig. 11. Another Straddle-milling Operation on a Light Type of Machine Equipped with a Hydraulic Table Feed

The tapping of holes in the small irregular-shaped casting seen in Fig. 9 has been simplified by the provision of a simple box type fixture, the principal purpose of which is to furnish a convenient holding means. The machine employed is a Bakewell precision tapping machine, which is equipped with a lead-screw and guide fingers for controlling the feed of the tap from the start to the finish of the thread being cut. A No. 10 tap with thirty-two threads per inch is used, the threads being cut within the close tolerance customarily specified on aircraft work. Nine holes are tapped in the part.

The application of a Sundstrand Rigidmil for straddle-milling both ends of aluminum alloy forgings is illustrated in Fig. 10. Four cutters are provided, two of which straddle-mill the long boss at one end of the forging, and the other two the narrow boss at the opposite end. The table is operated hydraulically at a fast feed to bring the work to the cutters, and then at a slow feed until the operation is completed. The width of the long boss is held to the specified size within plus or minus 0.002 inch, and the width of the narrow boss within plus or minus 0.005 inch. The relative position of the boss faces must also be held to close limits.

A somewhat similar operation performed on a Kent-Owens milling machine, which is also provided with a hydraulic table feed, is shown in Fig. 11. In this case, however, the flat hinge bracket being straddle-milled has only one boss to be finished, and therefore, only two cutters are used. This part is also an aluminum forging.

The milling operation shown in Fig. 12 is of unusual interest because of the automatic cycle of the machine. This is a Cincinnati No. 08 milling machine, actuated hydraulically. It is used for milling two Woodruff keyways in flap-control gear-shafts, such as seen in the fixture and at the front of the table.

After the fixture has been loaded, the table moves quickly to the right to locate the work beneath the

Fig. 12. Milling Two Woodruff Keyways in Flap-control Gear-shafts in an Operation that is Completely Automatic

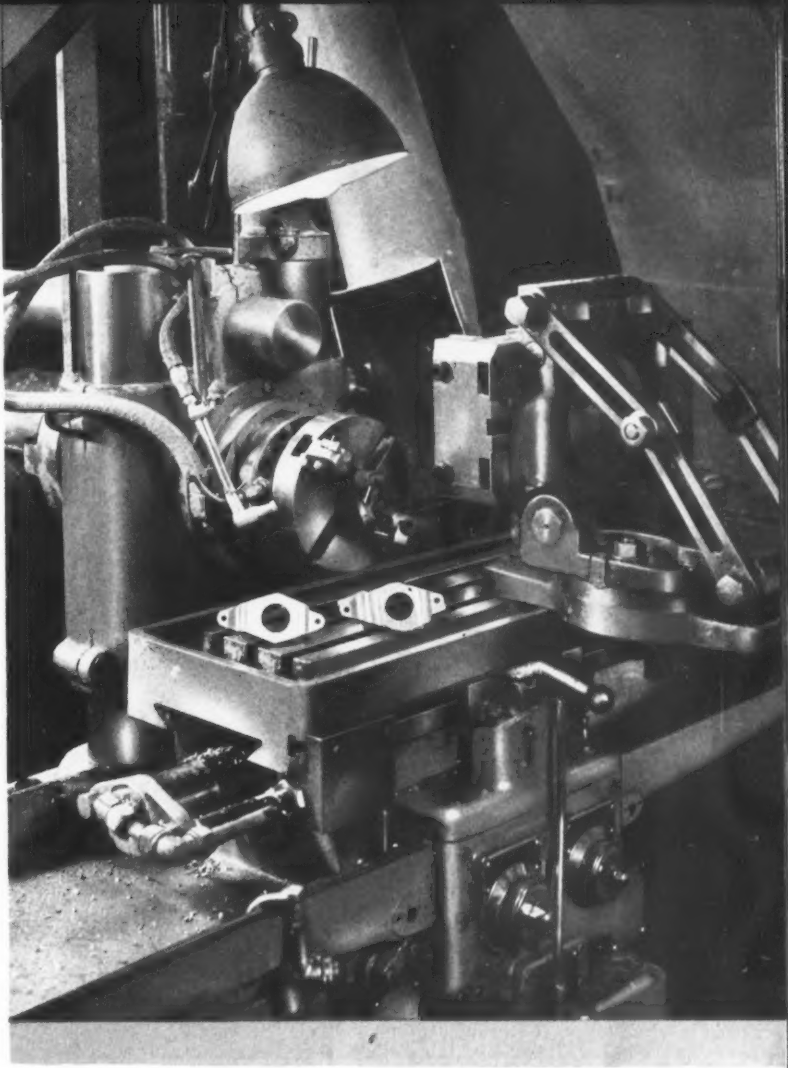


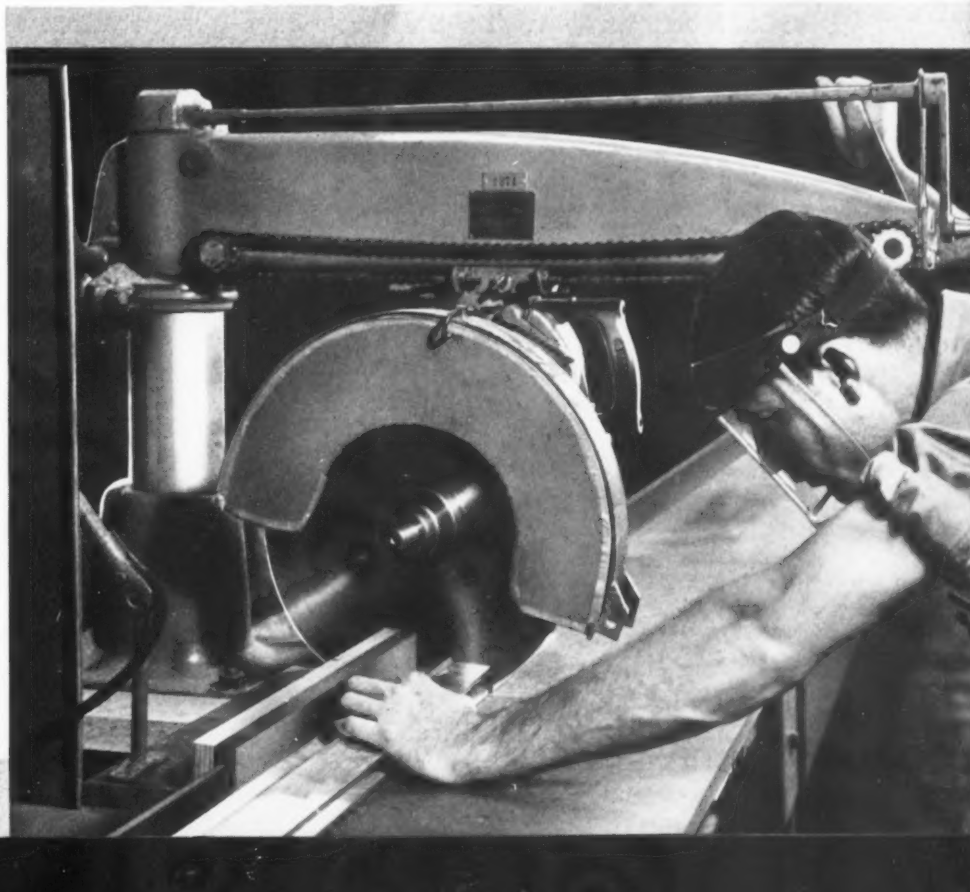
Fig. 13. High-cycle Milling Operation in which Three Knives Machine Irregular Edges of Work Seen on End of Table

cutter for machining the first keyway. The cutter-head then moves downward for the operation, after which it returns to its starting position. The table next travels farther to the right to locate the work for cutting the second keyway, the cutter-spindle again moving downward for this operation and then returning to its starting position. Finally, the table returns to the left, as illustrated, for reloading the fixture. All these movements are actuated by depressing one push-button. The width of the keyways is 0.1245 inch, plus 0.001 inch minus 0.0005 inch, while the depth is held to 0.141 inch within plus 0.005 inch minus 0.001 inch. The cutter is 1/2 inch in diameter.

The principle of high-cycle milling described in an article entitled "Vultee Methods Speed Production of Fighting Planes," which was published in July, 1940, MACHINERY, is being increasingly applied in this shop. Fig. 13 shows such an operation on a Kent-Owens milling machine equipped with a hydraulically actuated table. The cutter-head is provided with three knives that are sharpened in the same way as woodworking tools. Two of these knives are located near the periphery of the head for machining the edges of the work at angles from the center of each piece to the rounded ends. The third cutter, near the center of the head, which is ground to the radius of the ends on the work, machines these ends to the desired contour. The cutter-head runs at 7000 R.P.M. in this operation, but it can be run at various speeds ranging from 4000 to 9500 R.P.M. The table feeds to the right to carry the work past the cutters.

Cutting of extruded aluminum alloy shapes to required lengths has been facilitated by the installation of sawing equipment in back of long benches adjacent to the material storage department. In Fig. 14 a DeWalt sawing machine is being used to cut tail-wheel fittings from extruded stock. The saw is moved back and forth on an over-arm to sever the stock by manipulating a lever at the front end of the over-arm.

Fig. 14. Cutting Tail-wheel Fittings from Extruded Aluminum Alloy Shapes by Employing an Over-arm Type of Sawing Machine



Making Noses for MARTIN Bombers

Martin B-26 Bomber

COMPLETE vision for the combat crew of military airplanes is of vital importance. Any "blind spots" in their vision would permit enemy planes to come close unobserved, while other flaws would affect the gunners' aim. Protection against cold and violent blasts of air is also of utmost importance, as an almost frozen, wind-battered gunner or bombardier would be inclined to carelessness and inaccuracy.

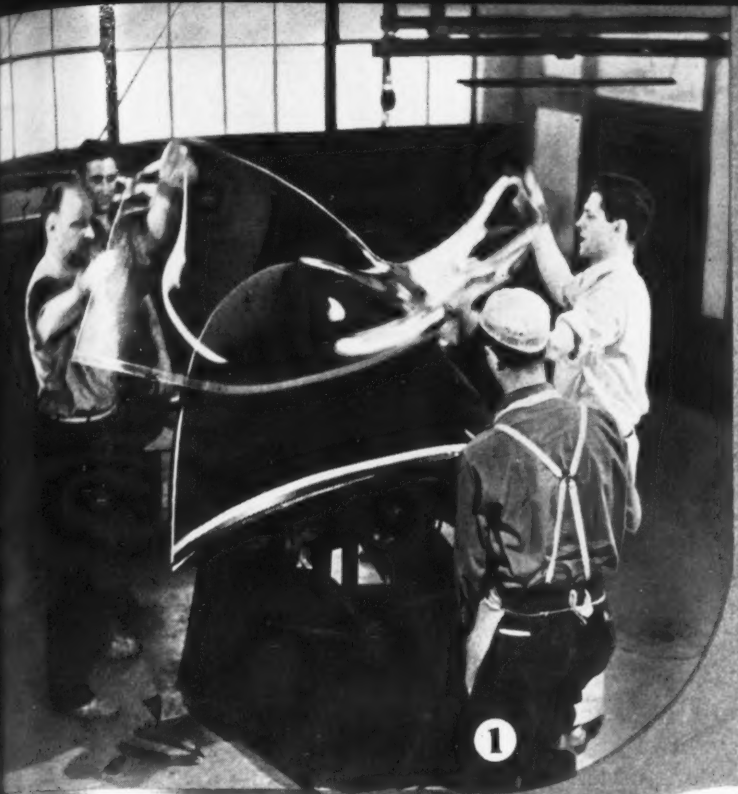
The fact that a human being can see, breathe, and keep warm while he sits in the transparent nose of a bomber flying at 375 miles an hour is as much a triumph of chemistry as of aeronautical science. All that stands between the bombardier and an air blast that would quickly tear off his clothes is a thin tough Plexiglas globe, which is more transparent than plate glass, even though made from such opaque materials as coal and oil. One of the latest American bombers, the Martin B-26, is provided with a nose, rear gun turret, observer's dome, tail empennage, and four fuselage windows, all made of Plexiglas. This bomber is shown in the heading illustration. Even when carrying its full complement of 2 1/2 tons of bombs, this plane is faster than most of the pursuit planes now fighting in the Eastern Hemisphere. Its five-man crew must have a clear vision of surrounding skies at all times.

Plexiglas is a crystal clear plastic that is shatterproof and weighs less than half the weight of glass. It was developed by the Rohm & Haas Co., Philadelphia, Pa., and can be formed into streamline parts strong enough to support machine gun mounts and to withstand the terrific air pressures developed in making plane dives at 400 miles an hour.

In forming these plastic sections to fit the streamline contour of military airplanes, the Plexiglas sheets are heated to 200 degrees F. to make them extremely pliable. In Fig. 1, a heated sheet is being shaped over a cloth-covered form to produce one half of a bomber nose. In Fig. 3 the sheet has been securely clamped to the form, where it remains until it is cool, thereby attaining the desired permanent shape. A number of identical forms are used, so that the same group of men can keep on clamping heated sheets of Plexiglas while others are cooling.

When the Plexiglas nose half has cooled, it is removed from the form and the irregular edges are trimmed off by a band saw. Such an operation is shown in Fig. 2. The two halves of a bomber nose are next cemented together by means of acrylic resin, the same resin as that from which Plexiglas sheets are originally made. This operation has already been performed on the bomber nose seen in Fig. 4, where the operator is engaged in trimming the edges of a bombardier's door and a gun-mount hole to receive hardware that will be bolted to the plastic material.

The final work in the production of the bomber nose consists of polishing and buffing. Workmen go over all surfaces carefully with cloths and power buffers, as illustrated in Fig. 5.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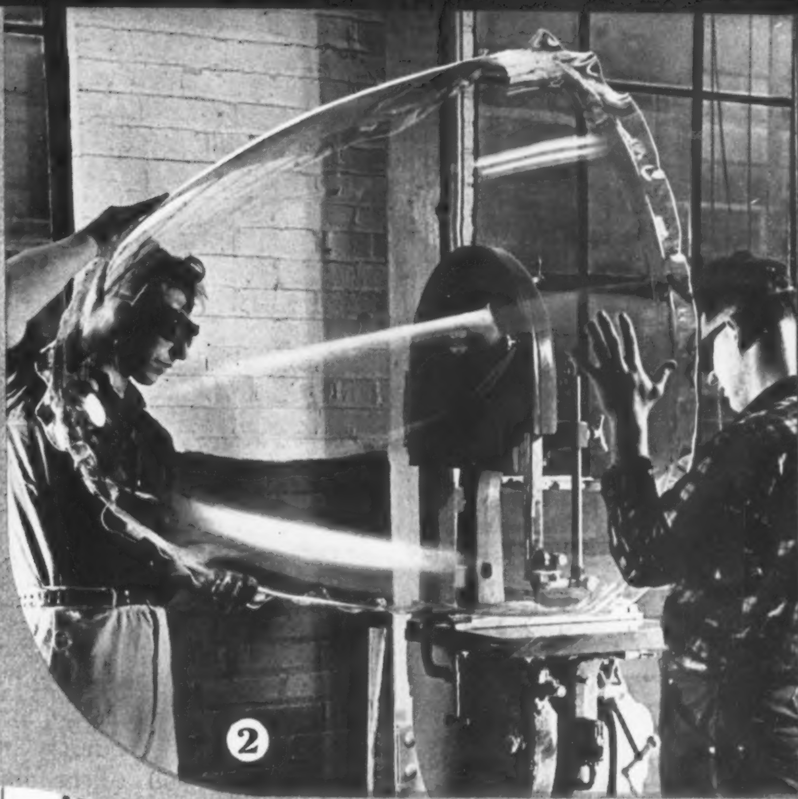
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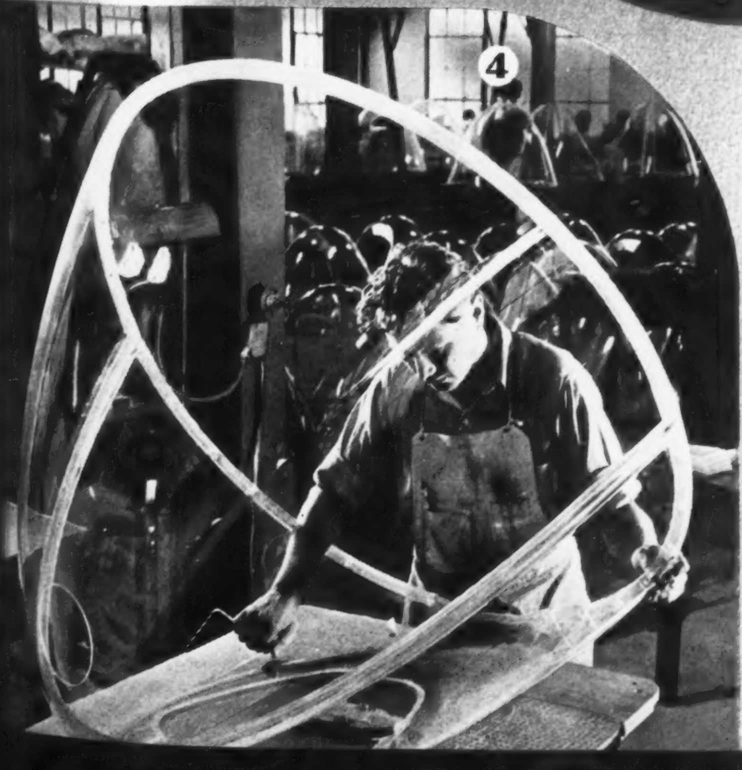
On the Target!


3


On the Target!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BOEING—Bomber Arsenal

FLYING Fortresses, first built in 1935 by the Boeing Aircraft Co., Seattle, Wash., constitute the principal output of that concern as the aircraft industry gears itself to supply fighting planes to the forces of the democracies. To fill large orders for these famed four-engine bombers of the United States Army Air Corps in the shortest possible time, the Boeing factory facilities in Seattle have been expanded by 1,500,000 square feet during the last year, giving a total manufacturing area of approximately 2,344,500 square feet. The number of employes has been increased during the past year from approximately 6000 to around 11,000 persons, and will be further increased to about 20,000.

Similar expansion of the Stearman Aircraft Division of the concern has been going on at Wichita, Kans., including the erection of a Flying Fortress sub-assembly plant, with the result that the total Boeing manufacturing area in the two cities amounts to 3,235,000 square feet, or five times the area at the beginning of the national emergency. In addition to Flying Fortresses, a smaller order of twin-engine attack bombers is being filled for the British Government by the Seattle factories, and great numbers of primary trainers are being produced by the Stearman factory in Wichita.

While most of the new manufacturing space in the Seattle factory is devoted to sub-assembly of plane sections and final assembly of the Flying Fortresses, a considerable area is occupied by a new machine shop that has been outfitted with modern machine tools. Typical operations performed in this shop will be described here.

Some of the most interesting operations are involved in machining wing terminals, of which there are four main types (with rights and lefts of each) in each Flying Fortress. The forged S A E 4340 steel blanks come into the shop weighing around 24 pounds, and by the time they have undergone a dozen machine operations, their weight has been reduced about half. The first operation consists of turning three or four steps on the shank end of the terminal, as shown in Fig. 1, where rough and machined terminals may be seen resting on the turret of the Warner & Swasey turret lathe employed for this operation.

The rough square end of the wing terminals is gripped in the chuck of the turret lathe by tightening a series of adjustable screws. A center drill mounted on one of the turret faces is then advanced for centering the overhanging end of the shank, after which the turret is indexed to bring a ball-bearing center into line with the work, as illustrated, for supporting the shank end during the turning cuts.

Firthite tools on the square turret are used in taking the turning cuts, stock being removed to a depth of about 5/64 inch on a side. There are two tools, one for turning the three shank steps, and one for chamfering the front end of the square portion that is gripped in the chuck.

The wing terminals are next drilled and bored in another Warner & Swasey turret lathe, shown in Fig. 3, only tools on the hexagonal turret being employed for this operation. The work is gripped on one of the previously turned surfaces to insure concentricity of the internal with the external surfaces. The first step consists of applying the center drill seen extending from the turret in the right-hand portion of the illustration. Then a long drill 1 3/8 inches in diameter is used to drill to a depth of 2 3/4 inches. A drill 1 5/32 inches in diameter next drills the piece to a depth of 5 3/4 inches.

A boring tool on the fourth turret face is then indexed into position for finishing the 1 3/8-inch hole, taking off about 1/16 inch of stock on the diameter. Then the 1 7/16-inch drill seen in action in Fig. 3 is applied to a depth of 5 3/4 inches. The 1 3/8-inch hole is finally finish-bored by a tool on the turret face seen to the left of the face that supports the center drill.

The terminals then go to a straddle-milling operation for a roughing cut on the outside faces of the fork end, after which a hole is drilled through the fork parallel to these faces. Following these preliminary operations, the wing terminal is heat-treated to a tensile strength of between 150,000 and 170,000 pounds per square inch.

Back in the machine shop, the terminal is center-drilled at both ends for finish-grinding the shank end. These surfaces are plunge-ground on the Cincinnati cylindrical grinding machine shown in Fig. 4 to specified diameters within limits of plus nothing, minus 0.003 inch. Approximately 0.030 inch of stock on the diameter is removed. The 4-inch grinding wheel is rounded on one side, so as to grind the fillets that join the different surfaces. The grinding wheel is fed straight in only. For this operation, the shank end is held on a special tail-stock center which enters the machined bore. A special dog and faceplate drive the square end. A magnifying mirror in back of the work, as seen in the illustration, gives the operator a clear view of the grinding at all times.

The wing terminals are then taken to a Racine hydraulic sawing machine (Fig. 6) for cutting out stock from the square end to form a fork. Two saw

of the Northwest

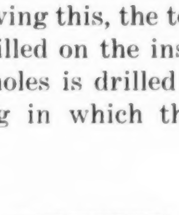
By CHARLES O. HERB

blades are provided on the machine, so that the block of material to be cut out is removed in one downward feed of the saw frame. The saw blades are 1 1/4 inches apart. Two wing terminals are sawed at one time.

The wing terminals are located by slipping an arbor through the previously drilled hole in the square end and through bushings on opposite sides of the fixture. Guide blocks in the center of the fixture steady the blades as they move back and forth through the wing terminals. They cut down to the hole through which the arbor was passed.

The fork surfaces on the end of the wing terminals are finished in several operations. The first of these is shown in Fig. 2 being performed on a Milwaukee vertical-spindle milling machine. It consists of finishing one of the outside fork surfaces to establish the desired angle of the yoke with respect to the center line through the shank. The work is accurately located in the fixture from the ground shank surfaces. Approximately 1/16 inch of stock is removed. In this operation, the table saddle feeds toward the machine column to carry the work under the cutter.

Following this, the terminal is placed in a jig and finish-milled on the inside of the fork. Then a series of holes is drilled through the fork, using another jig in which the terminal is located from



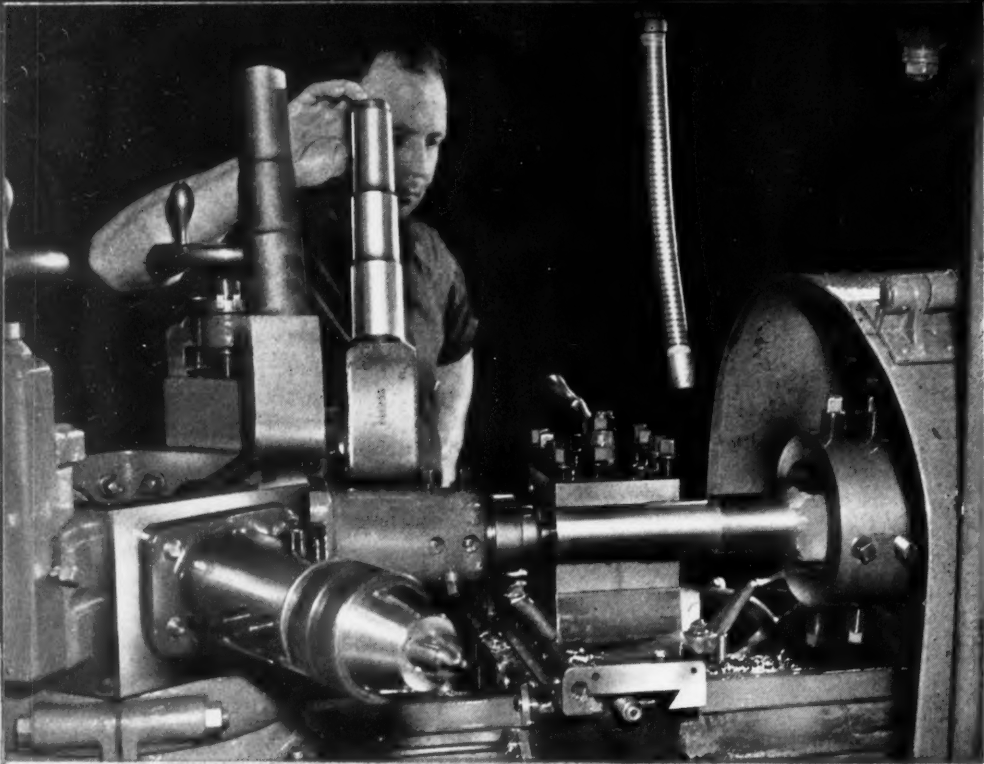


Fig. 1. (Left) Rough-turning the Shank End of Wing Terminal Forgings on a Turret Lathe

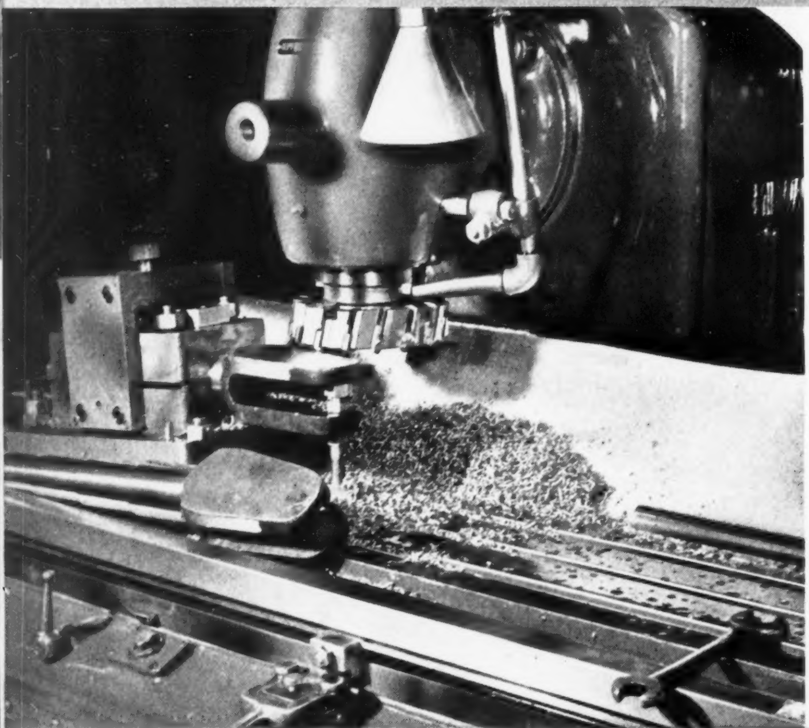


Fig. 2. (Center) Milling One of the Outside Fork Surfaces at an Angle with Respect to the Center Line through the Shank

the shank. A hole is next drilled through the shank itself in a jig which locates the part from the holes in the fork. An interesting operation is then performed by the Pratt & Whitney vertical shaper shown in Fig. 7 to finish the rounded contour of the fork end. The work is located on the simple fixture from one of the previously milled fork surfaces, and the rotary table is power-fed to gradually carry the rounded end past the reciprocating tool at the required radius.

DoAll band type sawing, filing, and polishing machines are used extensively for cutting small irregular-shaped pieces from steel plate. A machine of this type is employed to cut two terminal plates from one flat piece of material, laid out in such a way as to minimize scrap. The work is fed through the saw readily by holding a right-angle jaw against one corner of the material, this jaw being

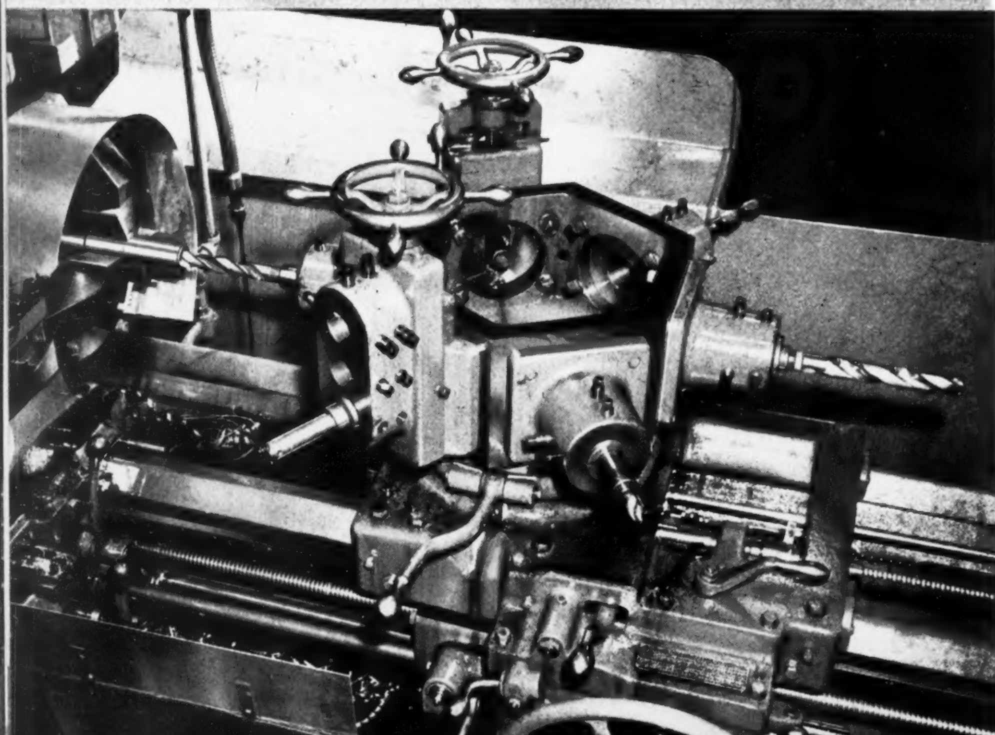


Fig. 3. Drilling and Boring Cuts are Taken in the Shank of the Wing Terminals with the Turret Lathe Set-up Here Shown

Fig. 4. (Right) Equipment Used for Grinding Three Steps on the Shanks of Wing Terminals

Fig. 5. (Center) Typical Operation on a DoAll Sawing, Filing and Polishing Machine, Showing Method of Feeding Work

pulled forward by a link chain and cable when the operator depresses a foot-pedal. This arrangement is shown in Fig. 5, the operation illustrated consisting of sawing off the end of tubing at an angle. The terminal plates are cut from S A E 4340 chromium-molybdenum steel 5/8 and 3/4 inch thick.

After the terminal plates have been faced to the thickness required, they are heat-treated, and any warpage that may develop is straightened under the Lempco power-driven arbor press illustrated in Fig. 9. The dial gage on the head of the press screw gives a close reading of the pressure being applied. The terminal plates are ground on both sides, and are then machined to three different heights on one side by the use of shapers. Next two of the shaped surfaces are ground on Thompson surface grinding machines set up as illustrated in Fig. 10. This operation is performed primarily to

Fig. 6. Two Saw Blades Simultaneously Cut out Blocks of Stock from the Square Ends of Two Wing Terminals

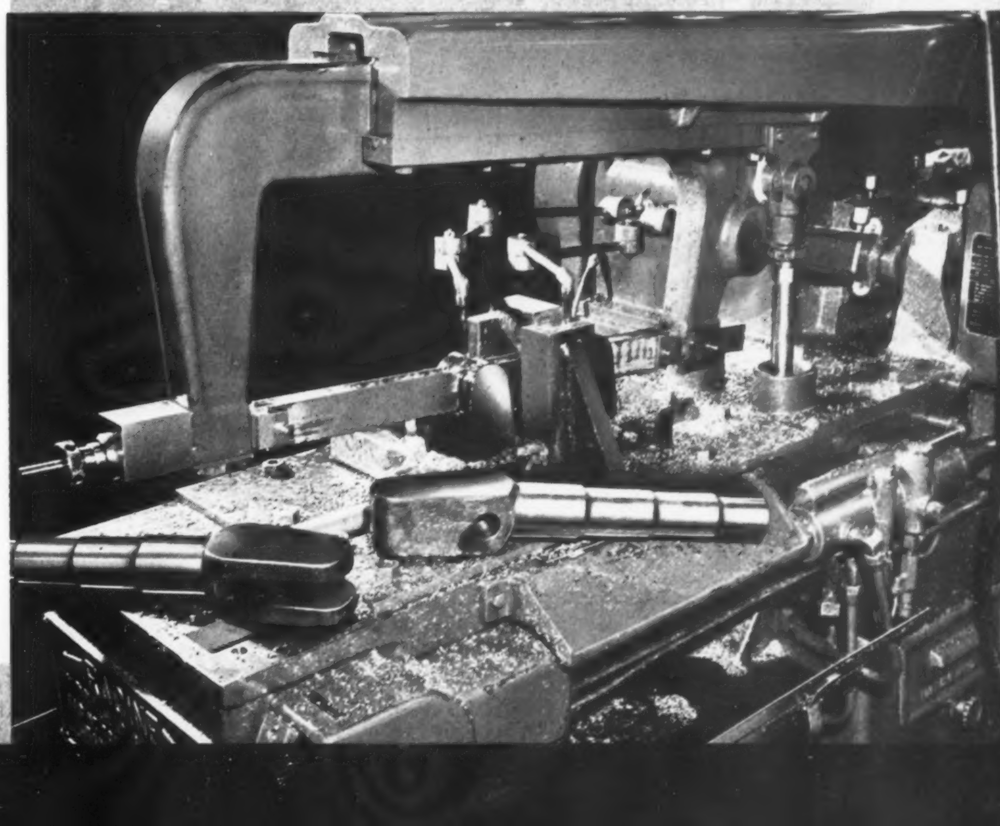
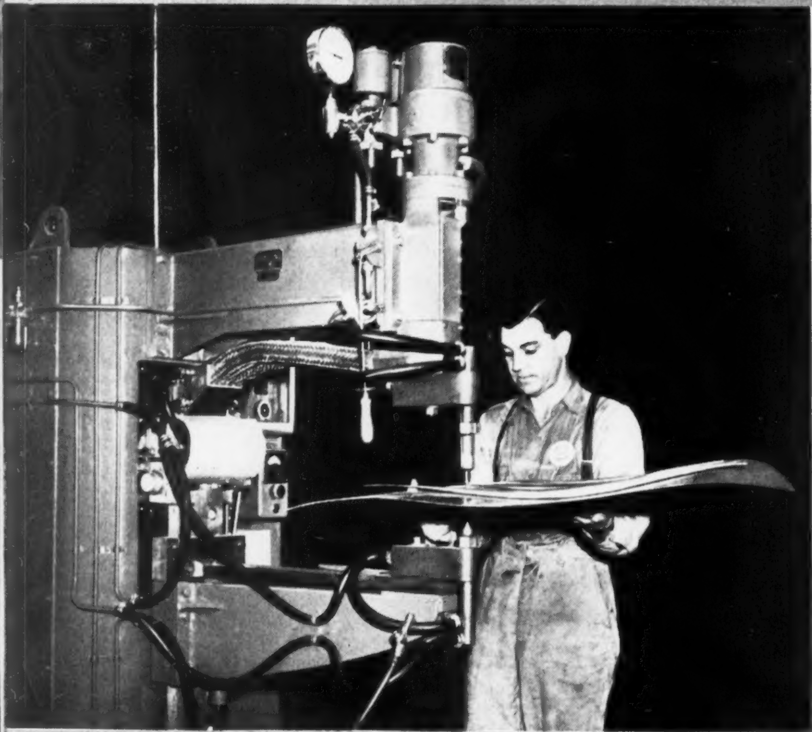


Fig. 7. (Left) Vertical Shaping Operation Performed to Finish the Rounded Ends of the Fork on Wing Terminals

Fig. 8. (Center) One of the Many Spot-welding Machines Used in Fabricating Aluminum and Stainless-steel Work



remove all tool marks, but specified dimensions must be held within plus or minus 0.005 inch. Four parts are held at one time on the magnetic chuck.

Fig. 12 shows a hole 2 5/8 inches in diameter being drilled through the solid stock of a tail-wheel knuckle forging on a Colburn single-spindle drilling machine. A straight hole is obtained through the 4-inch boss without a preliminary operation by a smaller pilot drill. The operation illustrated is performed before the part is hardened.

Fig. 8 shows a typical application of a Sciaky spot-welding machine, a battery of which has recently been installed in the factory for welding stainless-steel and aluminum-alloy sheet-metal parts. In the particular operation shown, fairing for nacelles is being welded. Taylor-Winfield spot-welders are also used.

A multiple punching operation performed on one

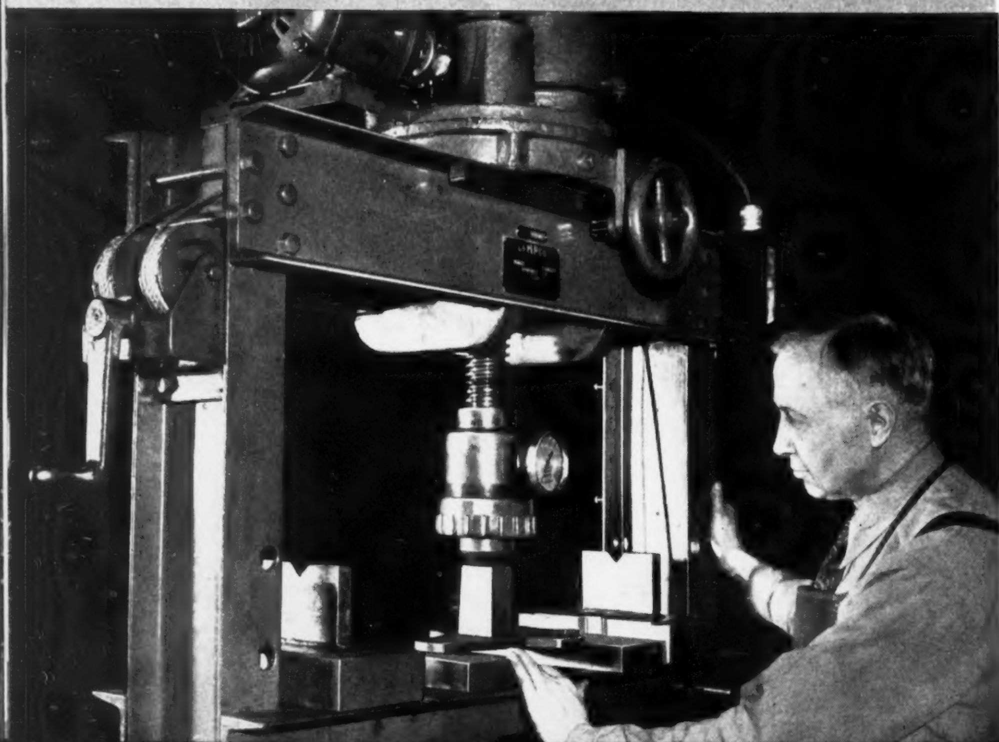
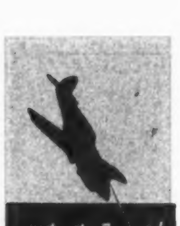


Fig. 9. Power-driven Arbor Press Employed for Straightening Terminal Plates after Heat-treatment, to Eliminate Warpage



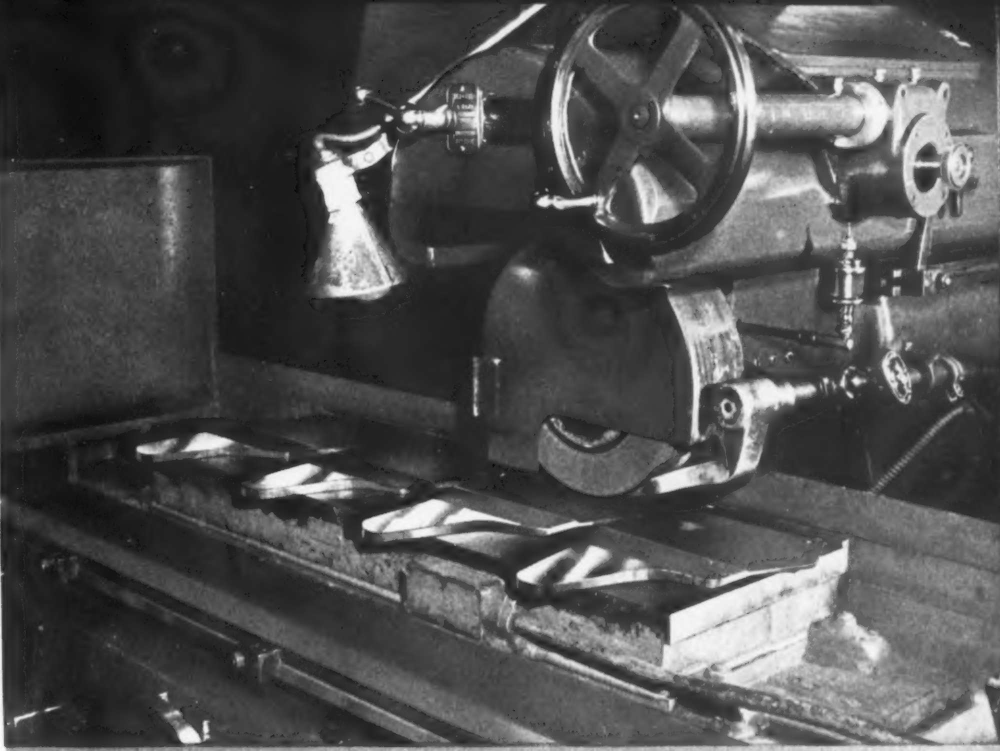
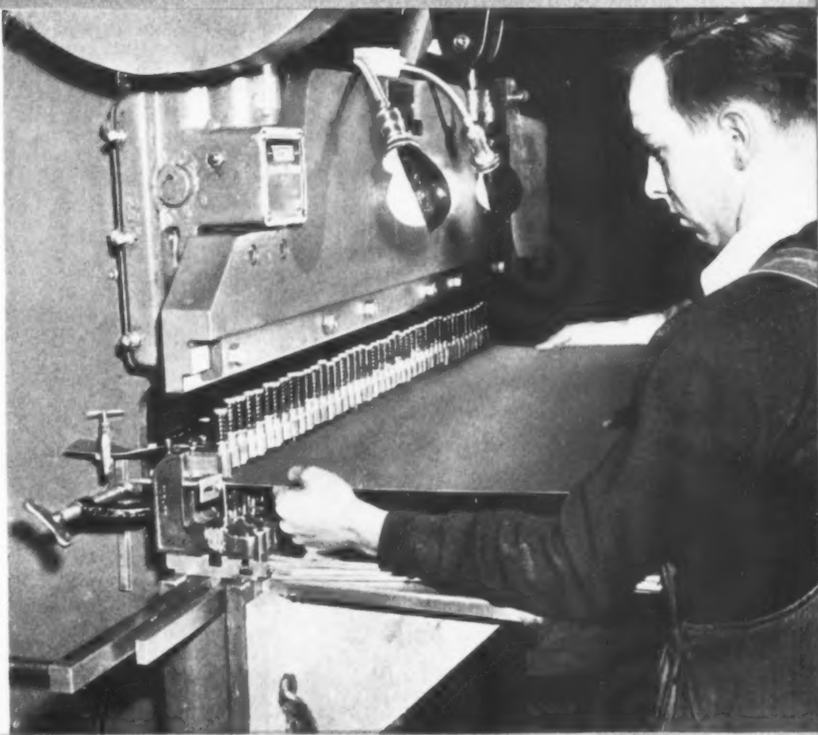


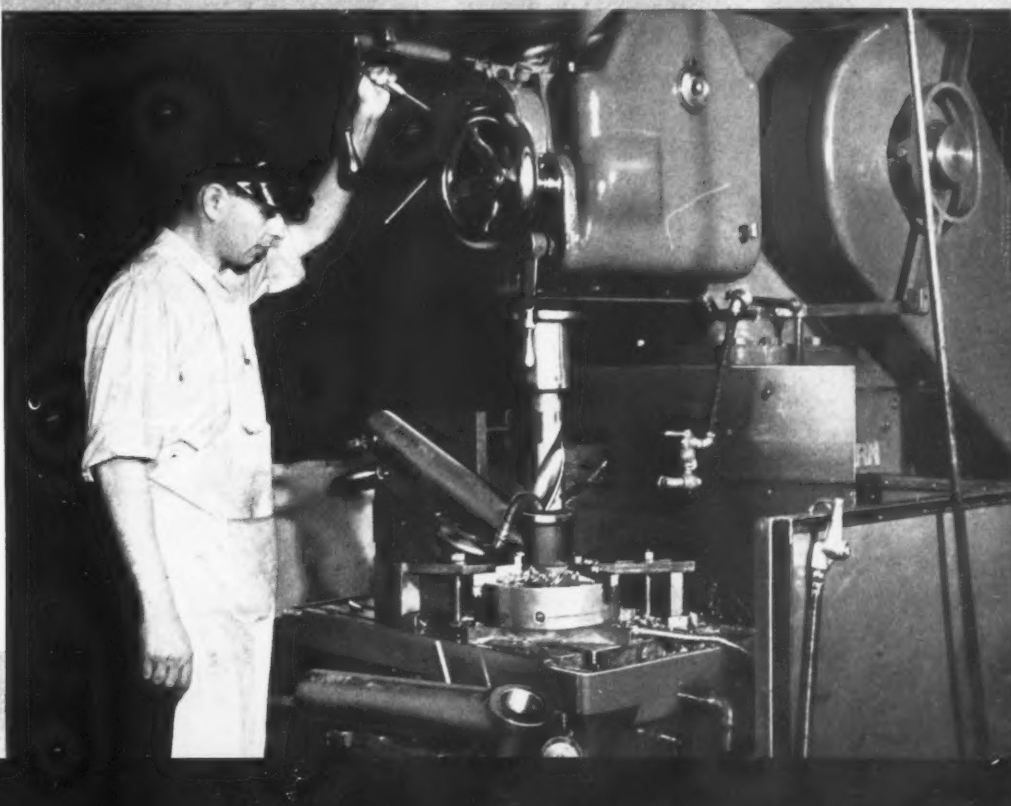
Fig. 10. (Right) Surface-grinding Two Surfaces on One Side of the Terminal Plates to Remove Tool Marks

Fig. 11. (Center) Punching Forty-four Holes at One Time with Dies that can be Adjusted to Different Center Distances



of the Verson All-Steel press brakes in the sheet-metal department is shown in Fig. 11. For this particular operation, the press is equipped with forty-four Wales adjustable dies for piercing 3/32-inch diameter holes through airplane skin. Each die is held in the bottom of a C-type holder and the punch in the upper arm of the holder. Coil springs normally keep the punch raised, so that the sheets to be punched can be readily slipped over the dies. When the ram descends, the springs are compressed so that the punches can be forced through the work. When the ram again moves upward, the springs withdraw the punches from the holes. The die-holders can be readily adjusted along the rail on which they are mounted to produce any required center-to-center distances between the punched holes. Some of the press brakes can accommodate twice as many Wales dies as the machine shown.

Fig. 12. Drilling a Hole 2 5/8 Inches in Diameter through the Boss on One End of a Tail-wheel Knuckle Forging



Operations that Speed up PRATT &

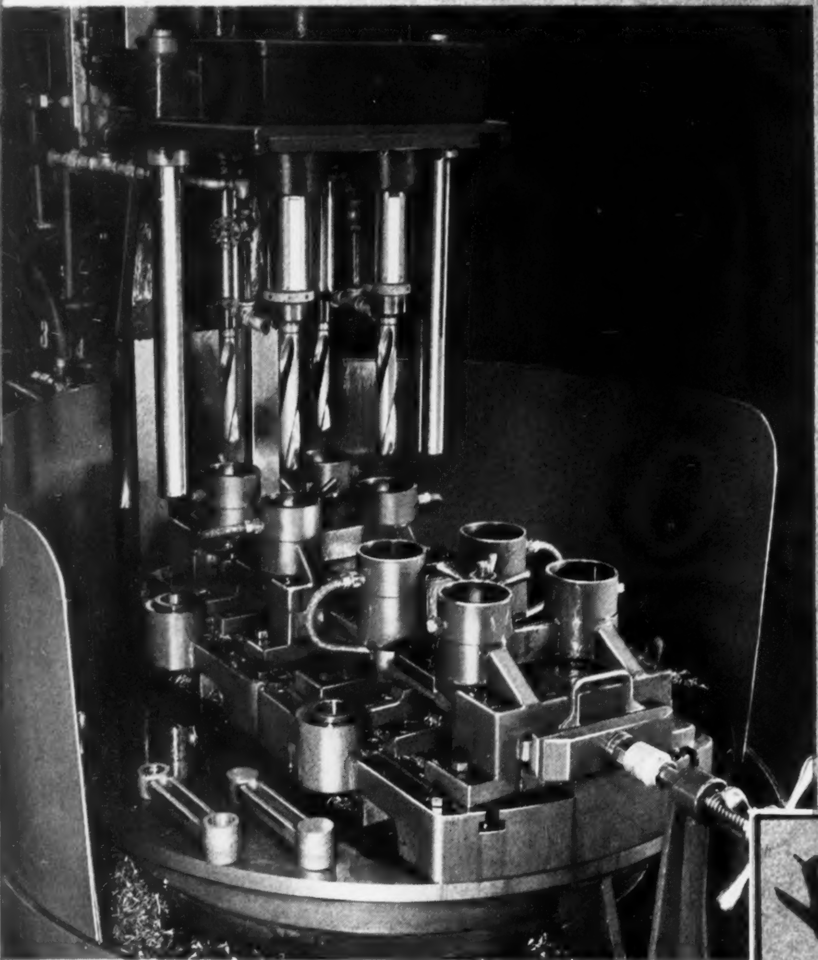


Fig. 1. Drilling the Holes in the Piston-pin and Knuckle-pin Bosses of Two Articulated Rods at One Time

Overhead Conveyors Distribute Finished Engine Parts to Various Store-rooms on the Mezzanine and First Floor of the

FOUR new factory buildings added during the last two years to the manufacturing facilities of the Pratt & Whitney Aircraft Division of the United Aircraft Corporation, East Hartford, Conn., give this division of the concern a total factory floor space of 1,600,000 square feet. The degree of this expansion is indicated by the fact that one of these buildings, completed last spring solely for engine assembly, is actually as large as the entire plant was two years ago.

Extensive studies were made by the engineering department prior to purchasing machine tools for the production lines to be installed in the new factory buildings, in order to insure the most intelligent application of the available funds. These studies uncovered a number of interesting facts, as, for example, that while machine tools ranging from $150 to $30,000 are necessary in manufacturing airplane engines, the average cost in a large buying program was $6500.

All machine tools are purchased on the basis of their ability to produce a given amount of work in a predetermined period of time. A balance must, of course, be maintained between the different types of machine tools bought, so as to insure an even flow of work along the production lines.

When production schedules have once been established, it is highly important that the machines operate as continuously as possible at their precalculated production rates. Unless machines are operated at 70 per cent of their estimated capacity, it is difficult to meet monthly engine schedules. Foremen are, therefore, constantly impressed with the importance of obtaining maximum production from each machine tool at the beginning of every month, so as to make up for the time that may later be lost in changing set-ups, repairing breakdowns, etc.

Many machine tools installed within recent months for the production of Pratt & Whitney's latest development, an eighteen-cylinder twin-row engine of 2000 horsepower, were designed specific-

& WHITNEY Engine Production

New Pratt & Whitney Assembly Building and Then to Sub-assembly Stations as Required to Meet Production Schedules

Fig. 2. Hydro-Tel Milling Machine Tooled up for Milling Channel in Both Sides of Master Rods

ally for quantity production and, therefore, embody original ideas on tooling that would be of exceptional interest to production engineers. However, due to governmental restrictions on the dissemination of knowledge concerning this engine, only a few of the machines used in its manufacture can be illustrated here.

Fig. 1 shows a Barnes four-spindle Hydram drilling machine being used for simultaneously drilling the piston- and knuckle-pin holes in two articulated connecting-rods. The holes in the bosses are of different sizes, one being 1 21/64 inches in diameter, and the other 1 31/64 inches. Duplicate sets of fixtures are provided so that parts can be loaded in one set while parts in the other set are being machined. Accurate location of the fixtures beneath the drill head is insured by the use of two long pilot bars on the multiple-spindle head which enter corresponding bushings on the fixtures. Each fixture is clamped and unclamped by a socket wrench at the front of the table.

The channels in the master rods are milled under the control of a tracer device by the Cincinnati Hydro-Tel milling machine shown in Fig. 2. The tracer is mounted on the right-hand side of the tool-head and slides in engagement with a templet mounted on an adjustable auxiliary table. The entire operation is performed automatically, the movements of the tracer being duplicated by the two cutters through an electrical control. The cutters move along one side of the channels from one end of the master rods to the other, and then back along the other side of the channels. Four fixtures are provided on the table, so that two of the fixtures can be loaded while an operation is in process on two rods held in the other two fixtures.

Another Cincinnati Hydro-Tel milling machine is illustrated in Fig. 3 tooled up for milling the channel in four articulated rods at one time. In this case, there is no necessity for employing a tracer, as the cutter-head merely feeds the four cutters downward to depth, and then in a straight path

Fig. 3. Another Hydro-Tel Milling Machine Tooled up for Milling the Channel in Four Articulated Connecting-rods at the Same Time

from the wrist-pin boss to the knuckle-pin boss of each rod. The full width of the channels is milled in one pass of the cutters. At the end of the milling operation, the cutters rise, and the cutter-head recedes to the starting position. This machine is provided with eight fixtures, so that four of them can be loaded while an operation is in progress.

In Fig. 4 is shown an operation that has become conventional practice in aircraft engine plants, but that may be novel to production men in other industries. It consists of shaping the wrist-pin boss of master rods to a cylindrical contour on a Fellows gear shaper. The master rod is indexed slowly by automatic means around a circle of the required diameter between reciprocations of the disk-like cutter.

Fig. 5 shows a special Kingsbury machine equipped with seven tool-heads for performing simultaneous drilling, countersinking, and spot-facing operations on a cylinder head. Each tool-head is provided with two or three cutter-spindles. The heads are arranged horizontally, vertically, and at various angles. The work is quickly clamped in the fixture by operating a cam-lever. This machine is one of three of the same type, which are operated as a battery. The first machine in each battery drills a considerable number of holes, the second machine is the one illustrated, and the third machine taps ten holes drilled in the previous operations.

A six-station Bullard Mult-Au-Matic tooled up for machining the combustion chamber in cylinder heads is illustrated in Fig. 6. As is customary practice, the first station of the machine is used for loading only. In the second station, tools are fed straight down for rough-boring the thread band

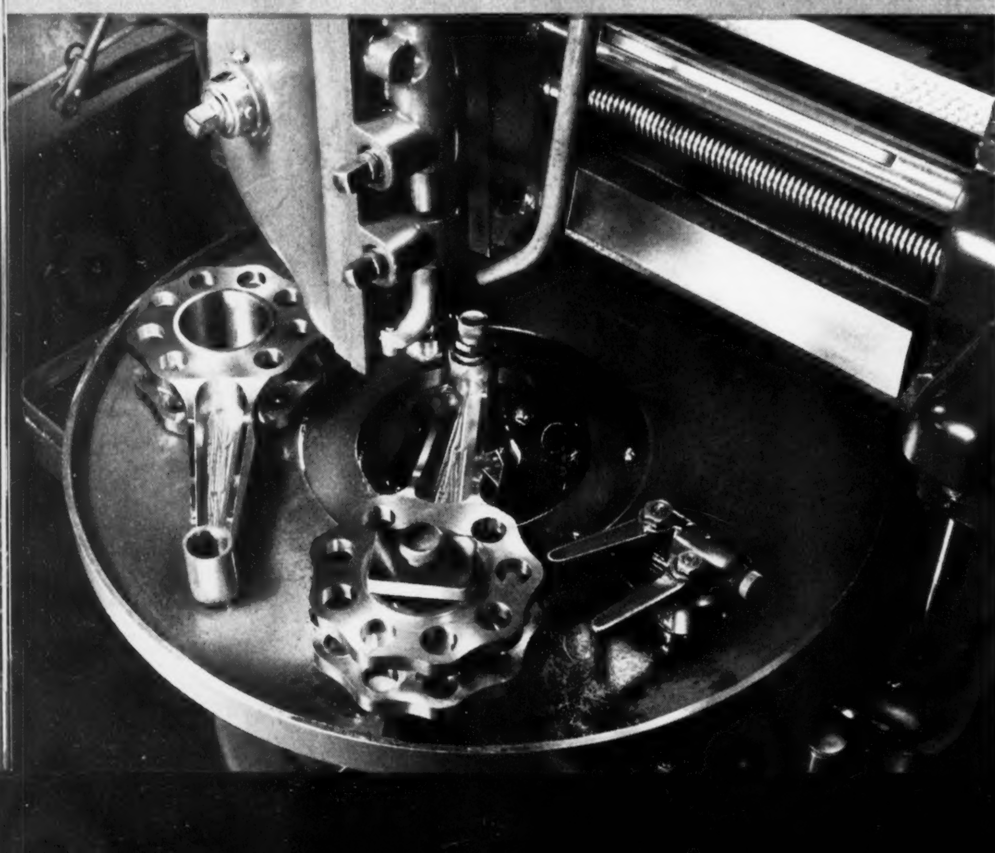


Fig. 4. Fellows Gear Shaper being Applied for Machining the Wrist-pin Boss on Master Rods

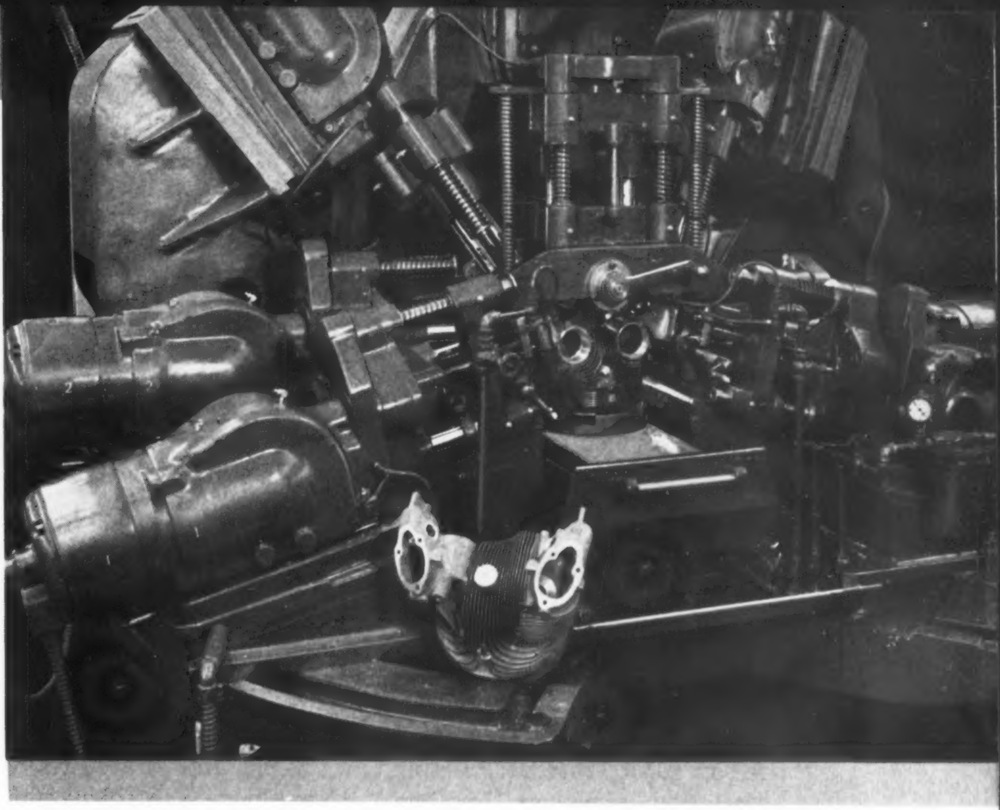


Fig. 5. Special Multiple-head Machine Equipped for Simultaneously Drilling, Countersinking, and Spot-facing Operations on Cylinder Heads

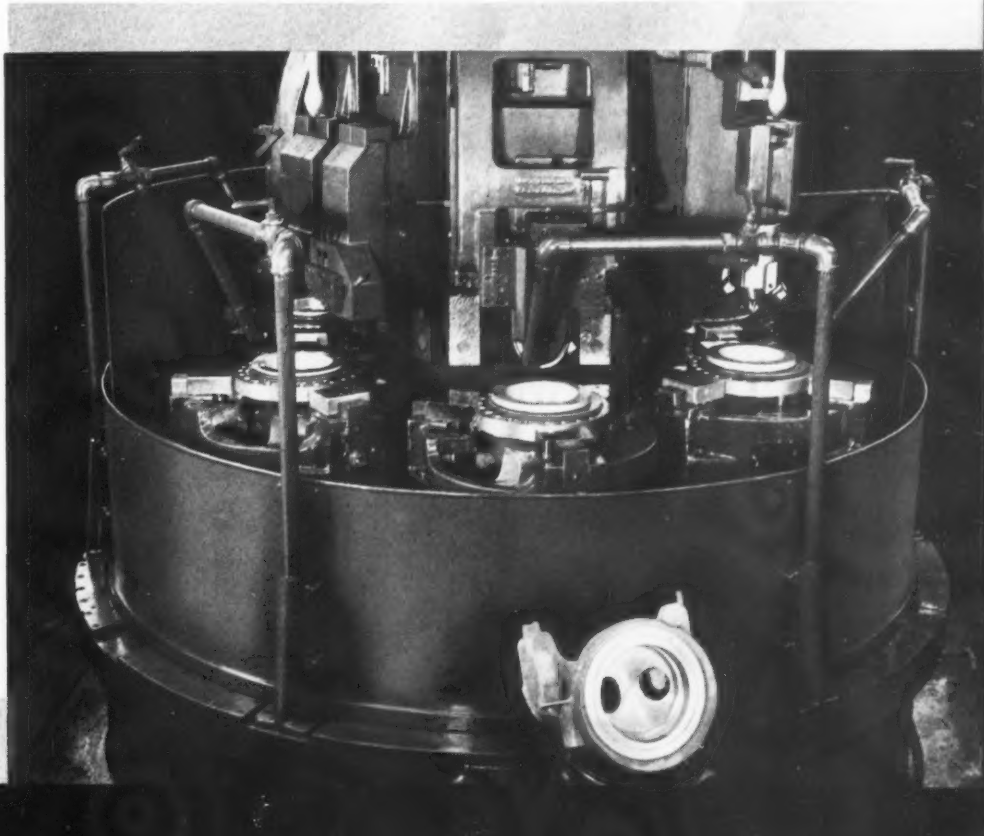
and shrink band, and "spotting" the dome. At the same time, a side tool rough-turns the flange.

In the third station, the dome is rough-turned to the required contour by the use of a tool which is swiveled to the proper radius after it has been fed into the cylinder head. The swiveling action is obtained through the sidewise movement of a cross-slide on the tool-head. This station is seen in the center of the illustration. In the next station, which is seen at the left, sets of tools are applied on both sides of the work for rough- and finish-facing two steps on the flange. On one side, the tools cut from the outside of the flange toward the center of the work, and on the other side, from the inside of the flange toward the outer edge. The sidewise movements commence after the tools have been fed down.

The fifth station of the machine is tooled up for finish-turning the dome by means of tools similar to those used in the third station. Finally, in the sixth station, a large reamer finishes the thread and shrink bands and cuts a bevel clearance for the piston. At the same time, a side tool finish-turns the periphery of the flange, and another side tool rounds the outer flange corner.

Operations in the new engine assembly plant have been greatly expedited by the provision of overhead conveyors for carrying work received from the machine shop and outside purveyors to storage departments, and from the various storerooms to stations on the assembly floor. The conveyor is almost one mile long and can carry a total load of 65,000 pounds at speeds of ten to thirty-five feet per minute. It is operated by two 3-H.P. motors. The heading illustration shows a general view of the new assembly shop, with the main floor storage area in the right foreground.

Fig. 6. Mult-Au-Matic Machining Dome, Thread and Shrink Bands, and Flange of Cylinder Heads



Building CONSOLIDATED'S

By PHILLIP KOENIG, Tool Supervisor
Consolidated Aircraft Corporation
San Diego, Calif.

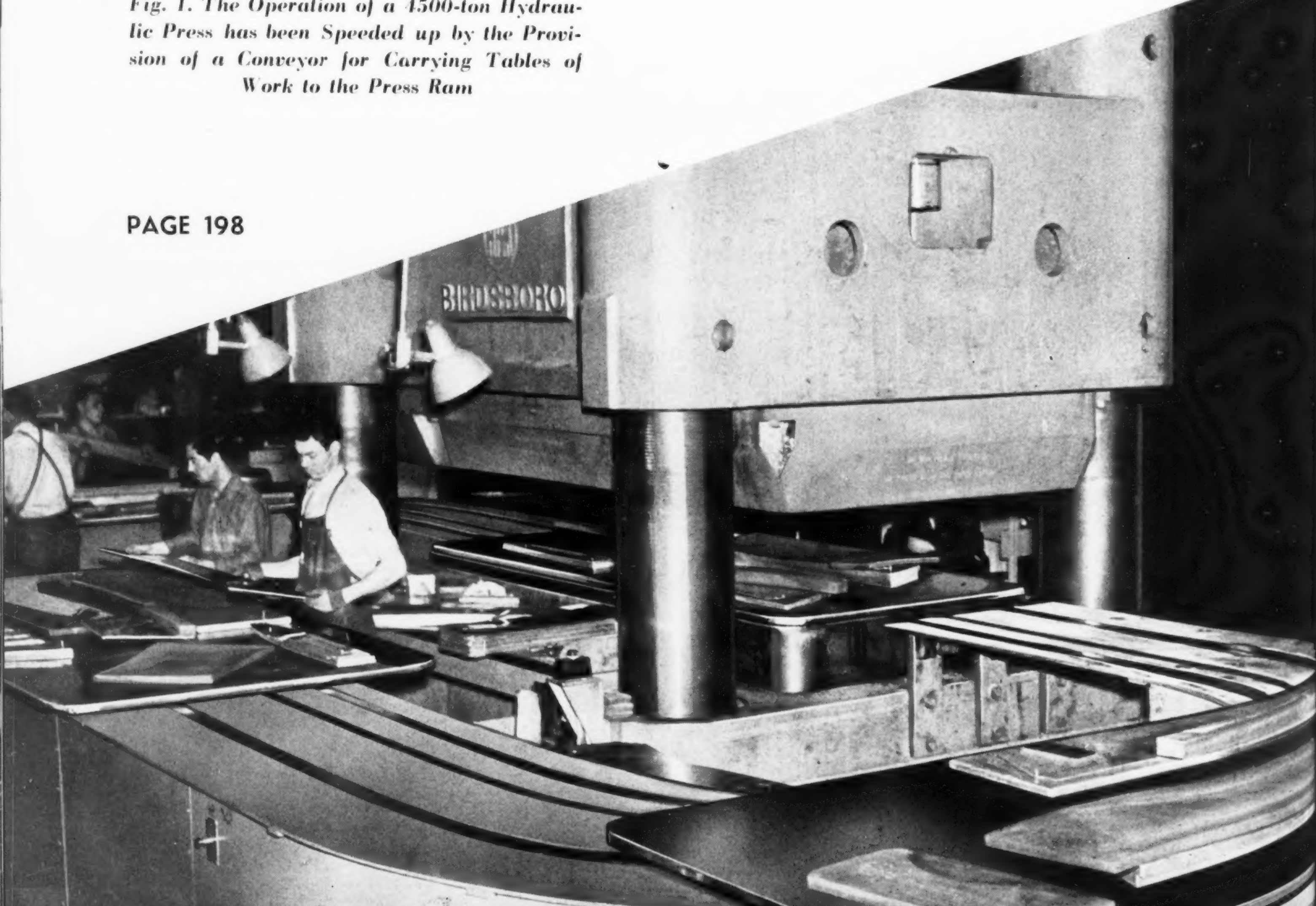
AFTER a five-year period of concentration on the building of flying military boats, the Consolidated Aircraft Corporation, San Diego, Calif., re-entered the land-plane field last year with the acceptance of a large bomber order from the United States Army Air Corps. This concern remains, however, the largest builder of flying boats for naval operations. Maximum efforts are now being directed toward turning out large numbers of two- and four-engine bombers for both land and ocean activities.

The factory at San Diego is being more than doubled in size, and when completed, late this summer, it will have over 3,000,000 square feet of covered floor space and 30,000 employes. In addition to this factory, a huge air-conditioned, windowless, "black-out" plant is being erected at Fort Worth, Tex. Upon the completion of that plant the total manufacturing floor space of the concern will be 5,600,000 square feet.

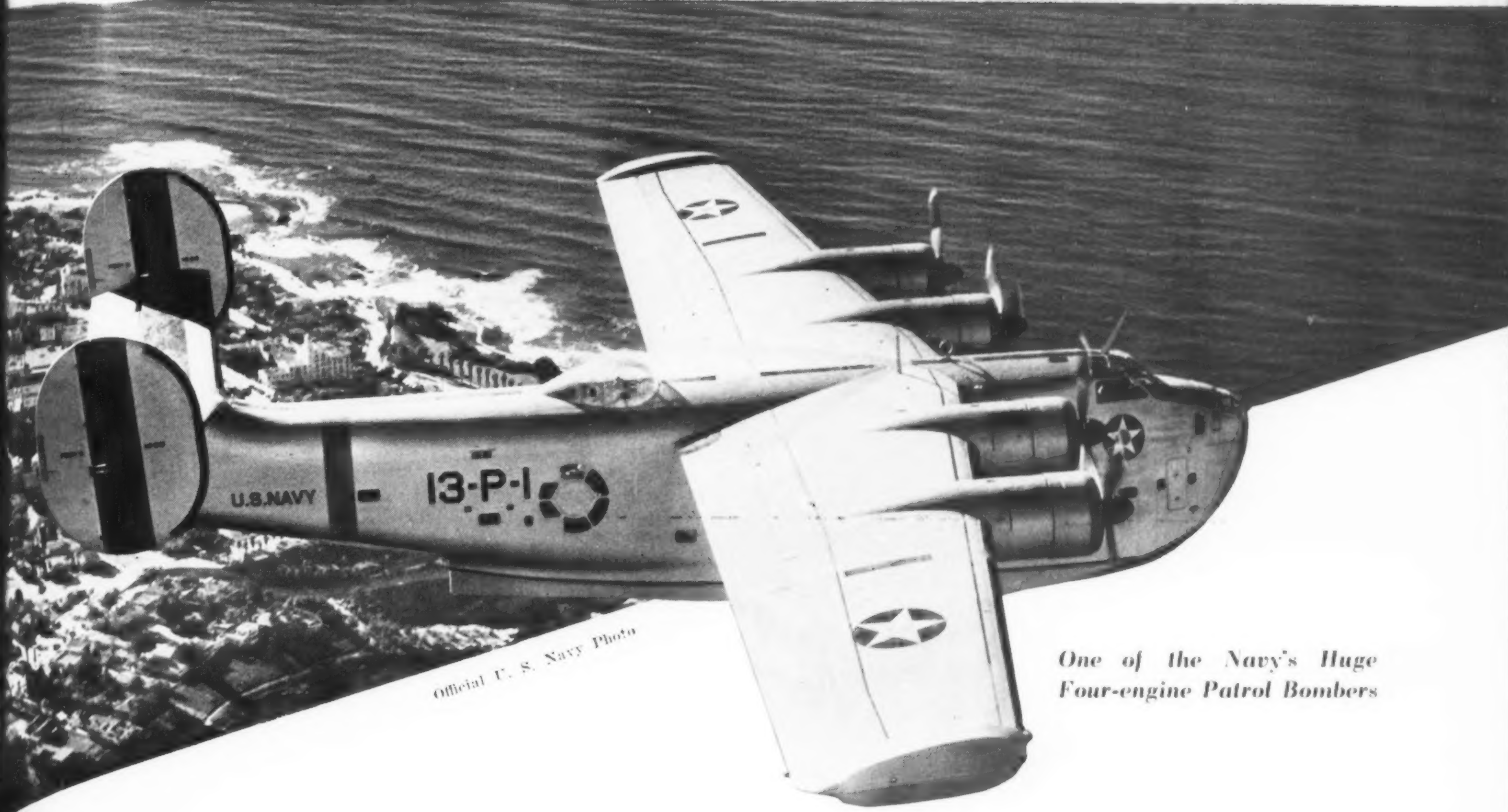
Operations followed at the San Diego factory are described in this article. The products at the present time consist mainly of the twin-engine military flying boat designated by the United States Navy as the PBY and the four-engine B-24 bomber of the United States Army Air Corps.

One of the most striking examples in this factory of a machine equipped for maximum production is the 4500-ton hydraulic press illustrated in Fig. 1, which has been provided with a conveyor for carrying the work platens into position beneath the press ram and returning them to unloading and reloading stations. The platens are steel plates, 10 feet 3 1/2 inches long by 4 feet 8 inches wide.

Fig. 1. The Operation of a 4500-ton Hydraulic Press has been Speeded up by the Provision of a Conveyor for Carrying Tables of Work to the Press Ram



Battleships of the Air



One of the Navy's Huge Four-engine Patrol Bombers

There are four of them. They slide around the conveyor on narrow flat ways of wide steel plates which form a sort of table that extends in a U form from one end of the press to the opposite end.

Between two of these steel plates there is a slot through which dogs on each platen extend. These dogs are bolted to a link chain beneath that is motor-driven intermittently in synchronism with the movements of the press ram. The chain carries a platen into position beneath the ram about every five minutes. Each platen is stopped automatically in the proper working position.

Seven men are ordinarily kept busy loading the platens with forms, sheets of metal on top of the forms, and blankets of rubber on top of the work, as well as unloading the finished work. In addition, there is a press operator, who stands constantly on the opposite side of the press to that seen in the illustration. The press ram is equipped with rubber pads to a thickness of about 10 1/4 inches for forming the metal work over the Masonite and zinc forms.

Magnetic punch-holders are used on many of the power presses employed in this shop for blanking and piercing operations. A Niagara press thus equipped is illustrated in Fig. 2. The punch used in such operations consists of a sheet of plow steel, from 1/8 to 3/16 inch thick, that has been cut out to the shape of the part to be blanked or the hole to be punched. In the particular operation illustrated, the punch was cut out to produce a large rectangular hole in sheets of aluminum alloy, as seen by the examples hanging on the front of the press. The plow-steel punch is riveted to 1/8-inch sheet-steel backing plate. Rubber strips cemented to the backing plate around the punch serve as strippers to force the work from the punch at the end of an operation.

The die is made from a sheet of Kirksite, 5/32 inch thick. It is riveted to 1/2-inch sheet-steel backing plate which is attached over dowel-pins to the die set fastened to the press. Rubber strips are also cemented to the die backing plate in the die cavity, which serve as a knock-out.

In setting up a press with such punch and die equipment, the die is put in place and then the punch is positioned over dowels in the upper part of the die set. The press ram is next brought down until the magnetic block comes in contact with the steel plate to which the punch is fastened, after which the punch is firmly held to the magnetic block for the performance of any number of operations. The magnets provided in the punch-holder are in the form of cylindrical plugs in some instances, and in the shape of the inserts provided on standard magnetic chucks in others. The inserts are energized by means of permanent magnets.

Long strips of sheet metal are formed at high

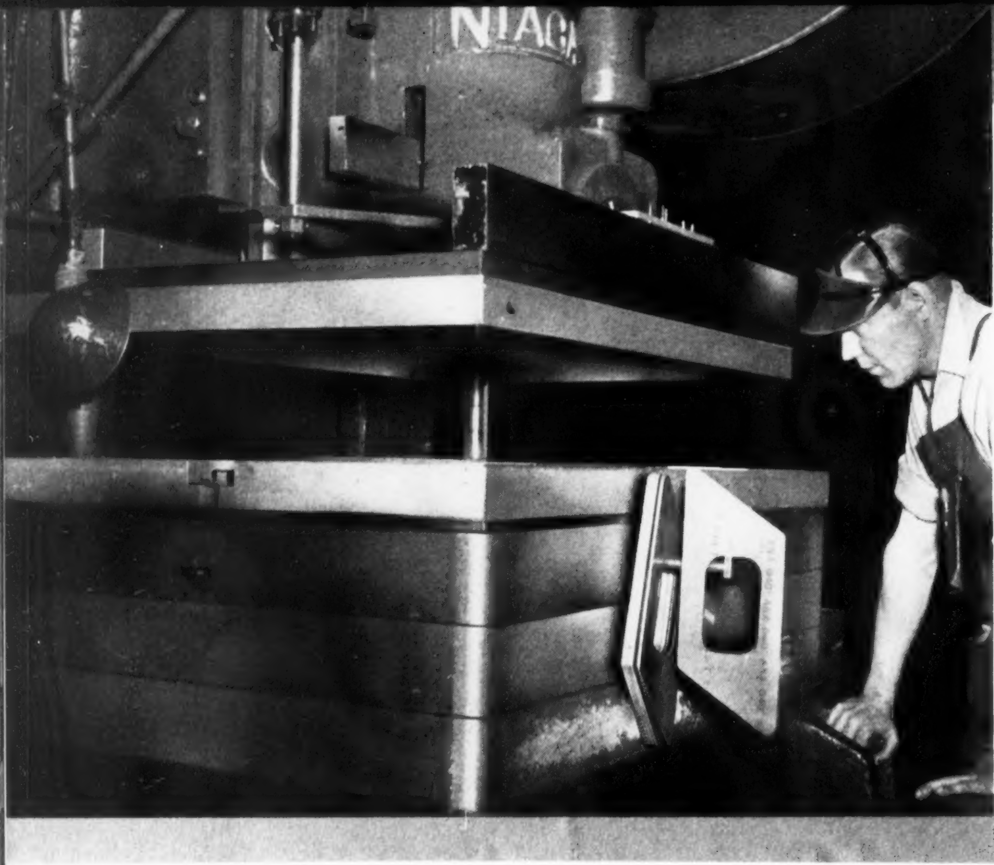


Fig. 2. Power Press Provided with a Magnetic Block for Holding Thin Punches of Plow Steel Securely in Line with the Die

speed to the required cross-sections from coil stock and then automatically cut off to specified lengths by means of the Yoder equipment illustrated in Fig. 3. In the particular operation shown, the work is of comparatively simple shape and is made of fairly narrow strip, so that it can be formed by using only two pairs of rolls on the machine seen at the right. For more complicated work, as many as seven sets of rolls may be used. The cutting-off machine, at the left, operates a vertical shear in synchronism with the rolls for cutting the stock when the required length has been fed past it.

Cecostamp pneumatic hammers are used extensively in this factory for drawing duralumin and stainless-steel parts of many descriptions. In Fig. 4 one of these machines is seen equipped with a lead punch and Kirksite die for drawing corrugated walk-way floors from duralumin. The corrugations are 30 inches long, 3/8 inch deep, and of 1 1/4 inches pitch, while the material is 0.040 inch thick. Another Cecostamp operation in which a part is being drawn considerably deeper, and at the same time curved to an irregular contour, is illustrated in Fig. 5. The part is a fairing piece for a nose cowl, and is also produced from duralumin. Again, the die is made of zinc alloy and the punch of lead.

One of the most interesting operations in the machine shop consists of chasing a thread on tubes

Fig. 3. Forming and Cutting-off Machines which Operate in Synchronism for Forming Sheet-metal Strips from Coil Stock and Cutting Them to Length

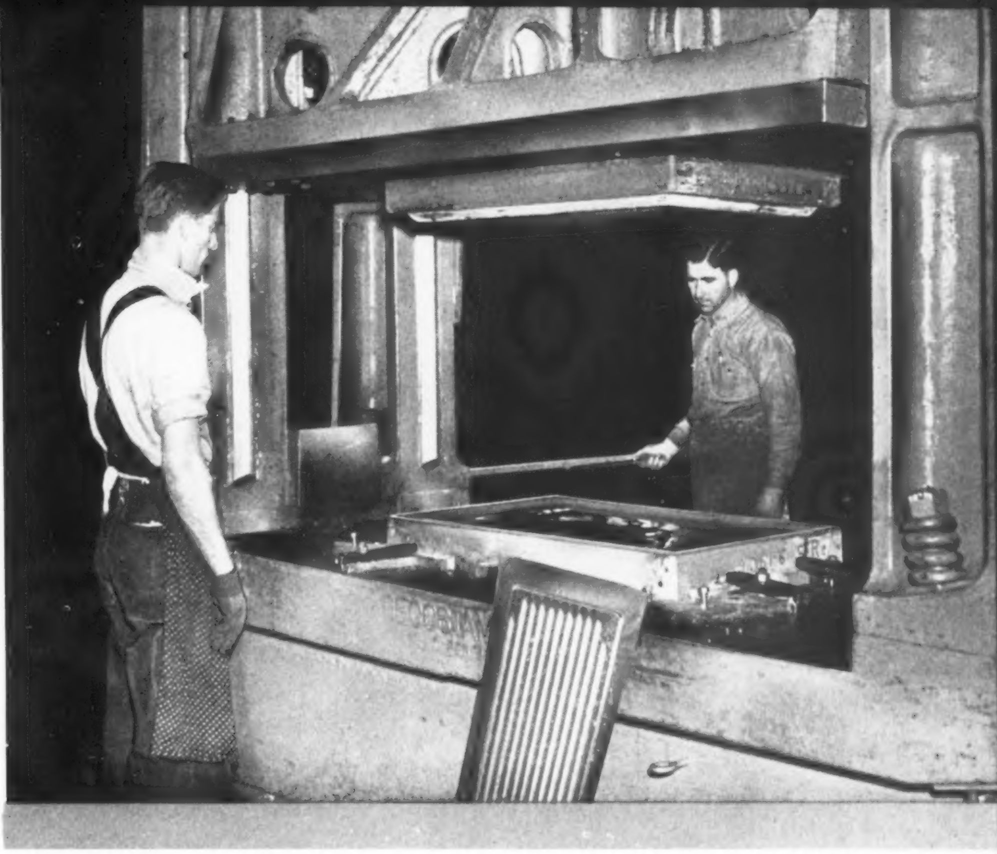


Fig. 4. Pneumatic Hammer with a Lead Punch and Zinc Die for Drawing Corrugated Walk-way Floors from Aluminum Sheets

67 inches long by 1.218 inches outside diameter, for use as float retracting screws on flying boats. The inside diameter of the tube is 0.890 inch, leaving a wall thickness of only 0.164 inch. The Acme double-lead thread, of 3 1/2 threads per inch, must be true as to pitch diameter within plus 0.002 inch, minus nothing, while the root diameter must be 0.900 inch, plus or minus nothing, as closely as can be checked with a depth micrometer. The outside diameter is held to plus 0.001 inch, minus 0.0005 inch. The tubing is of stainless steel.

Before each tube is brought to the Monarch lathe in which the operation is performed, as illustrated in Fig. 6, a rod 11/16 inch in diameter is inserted in the tube for approximately the full length, and the space between this rod and the inside of the tube is filled with molten Cerrobend to obtain, in effect, a solid bar. Plug centers are pressed into each end of the tube to facilitate holding it in the lathe. Rough cuts are taken on the screw thread until it has been cut to within 0.025 inch of its final depth and within 1/16 inch of the specified pitch diameter. From thirty to forty cuts are taken in this roughing operation.

The screw is then centerless-ground to obtain the proper outside diameter within the tolerance mentioned, after which it is returned to the Monarch lathe for the finishing cuts. From fifty to sixty

Fig. 5. Another Pneumatic Hammer Equipped for the Production of a Fairly Deep Drawn Piece, which is Curved to an Irregular Contour

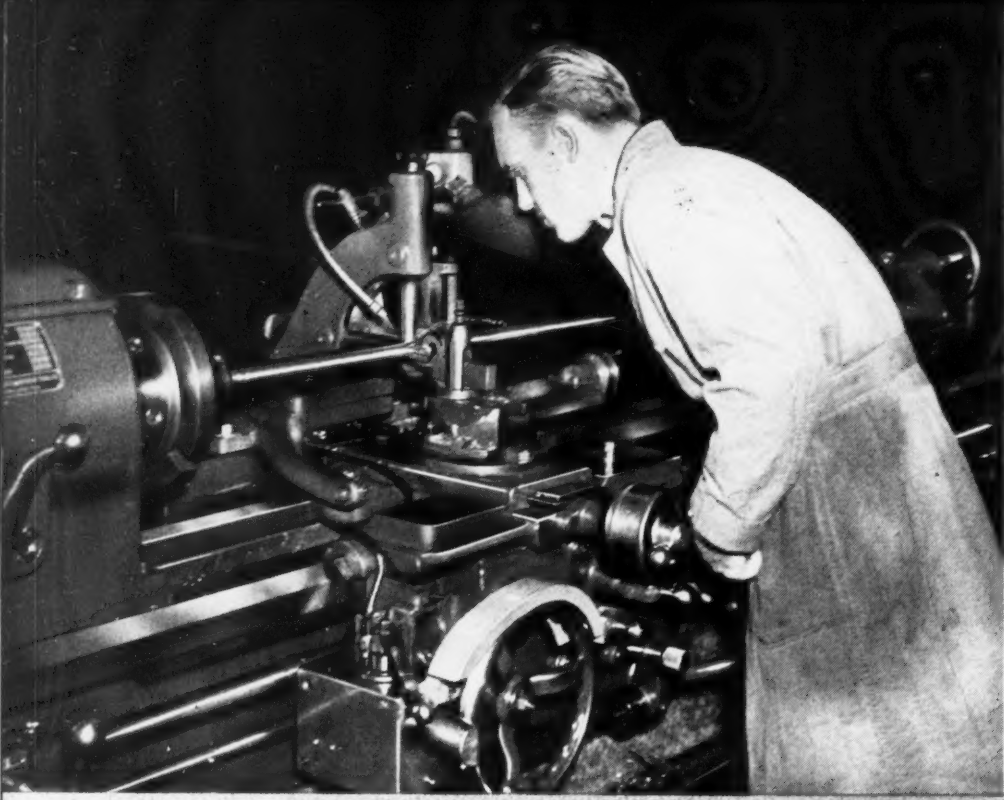


Fig. 6. Chasing Accurate Thread on a Long Tube that has been Filled with a Rod and Cerrobend to Provide Rigidity

cuts are taken in finishing. The large number of cuts taken in roughing and finishing are necessary because of the tendency of the metal to stretch under heavy cuts. Finishing cuts are taken at about 35 surface feet per minute. In both roughing and finishing, a spring-neck tool-holder is used, and the screw is supported opposite the cutter by means of Micarta blocks, mounted on a follow-rest. This eliminates chatter when the cutter is operating near the middle of the long tube.

When the tube leaves the thread-chasing lathe, it must run true for its full length within 0.005 inch. This necessitates at least seven straightening operations, the first before the tube is placed in the engine lathe, and the others between threading cuts. Straightening is performed on the Hannifin 20-ton hydraulic press shown in Fig. 7. In each operation, the tube is first placed between centers at the front of the table, and the run-out is determined by means of a knife-edge on a block that is slid along the screw by hand while the latter is being revolved. Chalk marks are made on the screw wherever corrections are necessary. The screw is then placed on anvils as shown, and the press ram brought down to apply force for straightening. A dial indicator tells the operator the amount of pressure being applied.

Small cable drums or pulleys are being turned

Fig. 7. Seven Straightening Operations are Ordinarily Performed before and during the Thread-cutting Operation Shown in Fig. 6

Fig. 8. Fastermatic Tooled up for Machining Small Cable Drums, during which Operation the Drums are Faced on Both Ends

out on a quantity production basis by the Foster Fastermatic illustrated in Fig. 8. The parts are duralumin castings. The first step in this operation consists of boring, chamfering, and facing the hub, all cuts being taken by tools mounted on one station of the turret. Then the part is simultaneously faced on both sides at the rim by means of cutters on the cross-slides, one at the front and one at the back. At the same time, a cutter on the front cross-slide forms the complete periphery of the drum.

During the cross-slide cuts, the work is supported by a large conical center on a second station of the turret. This provision is necessary because the forging is gripped under the flange by the chuck jaws, and this holding surface has considerable draft. If the hub were unsupported, the cutting pressure would tend to pull the work-piece off the chuck jaws.

When the facing and forming cuts have been completed, a tool on the third turret face finish-bores the drum, and then a tool on the fourth turret face reams the bore.

Fig. 9 shows a Warner & Swasey turret lathe being employed for producing bulkhead nipples from 1 3/4-inch hexagonal aluminum alloy bar stock. One of the finished pieces is seen resting on the hexagonal turret. In this operation, the stock

Fig. 9. Turret Lathe Tooled up for Producing Bulkhead Nipples Complete from Hexagonal Bar Stock Except for Threading

Fig. 10. Punching Holes of Different Sizes in Sheet Material through the Use of a Punching Machine Equipped with a Turret that Carries as Many as Eighteen Punches

is first fed to a stop on the hexagonal turret, after which the end is turned by means of a tool on the square turret at the front of the cross-slide. Then a forming cut is taken with a second tool on the square turret, and the corners of the hexagon stock are chamfered with a third tool on the square turret.

The end of the bar is next center-drilled with a tool on the hexagonal turret and then drilled to 3/4-inch diameter by means of a drill on the third face of the hexagonal turret. Next a 1 1/8-inch drill on this turret cuts to a depth of 2 1/16 inches, this operation having just been completed when the photograph was taken. Finally, the part is cut off from the bar by means of a tool that is mounted on the rear of the cross-slide.

Holes from 1/8 inch to 3 inches in diameter can be pierced through sheet metal by the Wiedemann turret type punching machine shown in Fig. 10. The turret is provided with eighteen stations, any of which can be instantly indexed into position beneath the press ram for piercing holes to desired diameters. Only the punch that is beneath the press ram is actuated.

One of the many spot-welding operations performed in the factory is shown in Fig. 11. In this operation, a Sciaky spot-welder provided with a roller electrode makes a series of spot-welds, superimposed on one another, as the work is moved under the roller, to obtain an air-tight seam. The piece being operated on is part of the duct of an air cooler. It is made from sheet duralumin.

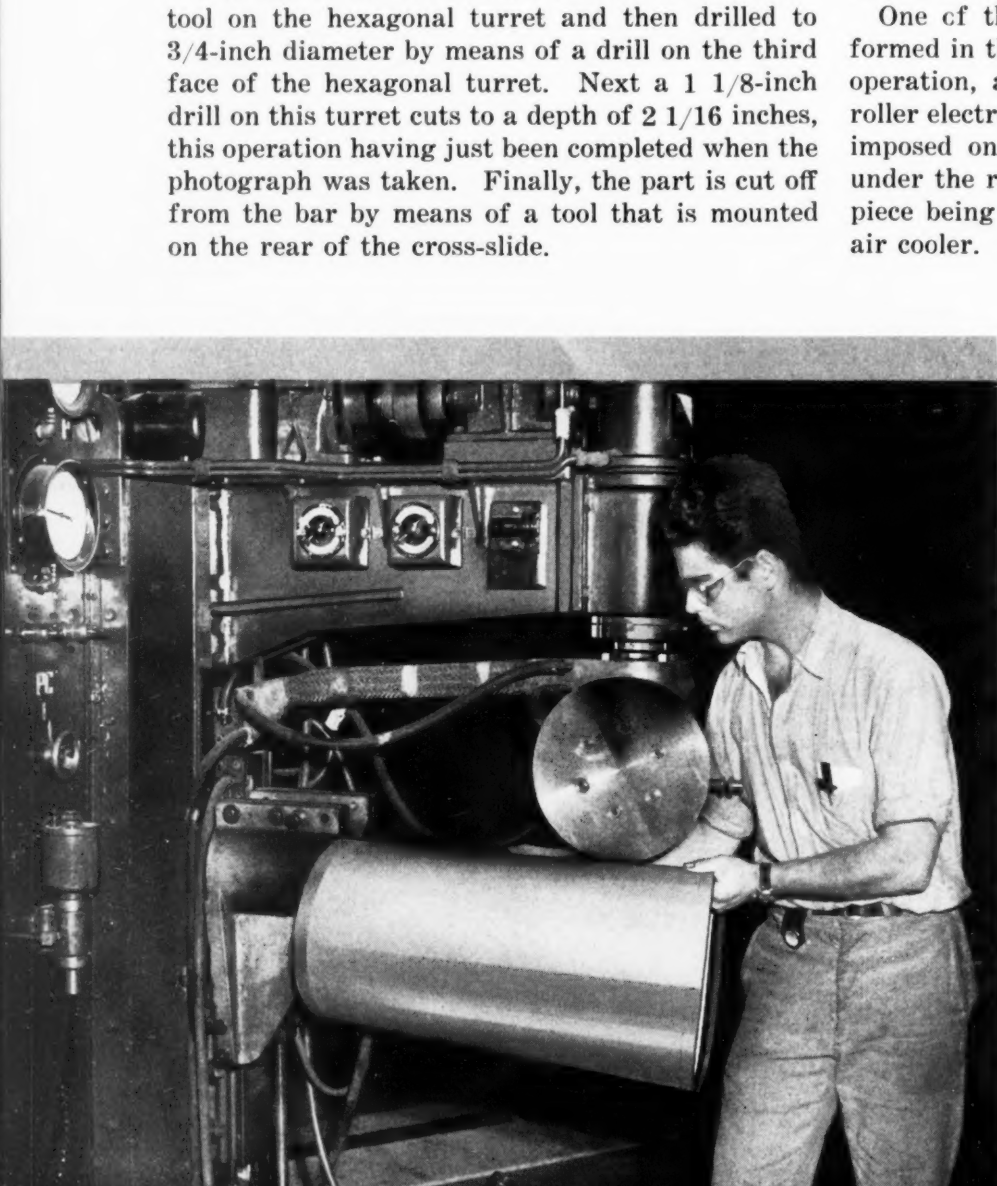


Fig. 11. Spot-welding Operation in which a Roller Type Electrode Makes an Air-tight Seam in Air Ducts

Engineering News Flashes

Light for the New Douglas Windowless Airplane Plant

High levels of light to speed the production of aircraft will be provided by 10,000 Westinghouse 400-watt mercury-vapor lamps and 15,000 fluorescent lamps installed in the new windowless plant of the Douglas Aircraft Co. at Long Beach, Calif. For illuminating the factory working areas, the mercury lamps will be mounted in conventional low-bay and high-bay industrial reflectors, varying in mounting height from 22 to 35 feet and placed on 12 1/2- by 12 1/2-foot centers. The illumination on a working plane 30 inches above the floor will average 30 foot-candles.

The fluorescent lamps will provide approximately 45 foot-candles of illumination on desks and tables in offices and drafting-rooms, and will light what officials believe will be the world's largest cafeteria for employes. The new Douglas plant will have more than 1,000,000 square feet of manufacturing area scattered over a 200-acre plot. The buildings will be invisible at night because of "light traps" inside of all doors, absence of windows, and camouflage landscaping.

Increasing Use of Roller Bearings on Locomotives

In proceeding with its locomotive modernization program, the Northern Pacific Railroad is equipping twelve of the world's largest, most powerful locomotives with Timken roller bearings. Fourteen new locomotives ordered for the same railroad will be similarly equipped. This type of roller bearings is also replacing babbitted thrust bearings in marine construction. There has been a decided trend toward the use of tapered roller bearings for propeller shafts because of the increased thrust loads set up in modern Diesel engine installations.

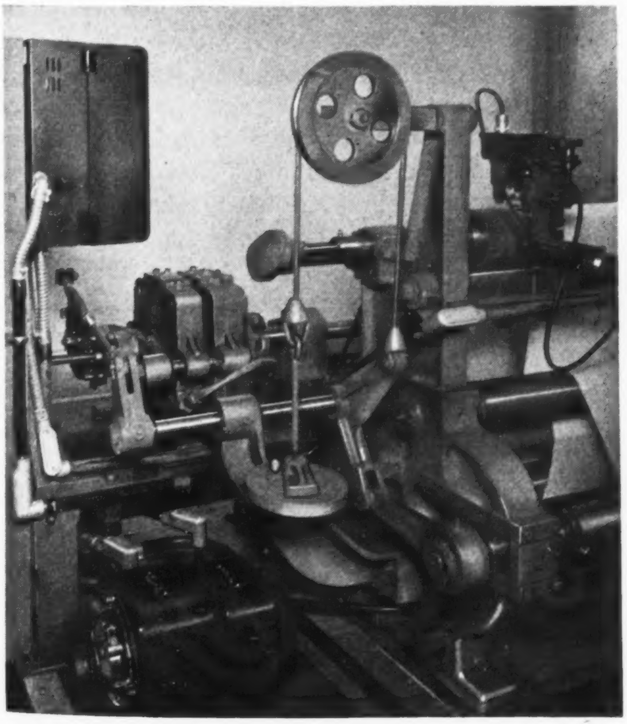
Huge Pipe Line for Hydro-Electric Power Plant

At Los Quilos, Chile, a hydro-electric power plant is being built 4000 feet up in the Andes Mountains. About 2900 gallons of water per second will be used to drive the water turbines of the Westinghouse water-wheel generators at a speed of 3000 R.P.M. The water is carried from two rivers higher up in the mountains to the power plant by means of a huge pipe line, tapered from 56 to 42 inches in diameter.

High-Pressure Steam Lines Fabricated by Arc Welding

Installation of high-pressure steam lines with welded joints, which operate at 1300 pounds pressure and 900 degrees F. temperature, has just been completed by the Dayton Power & Light Co. at its Millers Ford Station, Dayton, Ohio. To withstand the high pressure and temperature, it was necessary to use carbon-molybdenum steel which has excellent physical properties and resistance to creep at high temperatures. In order to maintain the same properties in the welded joints, a General Electric carbon-steel electrode containing molybdenum in the coating was used.

The base metal on each side adjacent to the weld was heated slowly to approximately 500 degrees F. by means of electric resistance heater units. This temperature was maintained during the welding by enclosing the resistance heater units in asbestos covering. After the weld was completed, an asbestos covering was also put over the welded joint in order to retard the cooling.



If the Paper Unwound from the Roll on the Cameron Winder and Slitter Here Shown should be Out of Line, a General Electric Photo-electric Side-register Control System would Guide it Back to the Proper Track. An Amplidyne Generator Controlled by a Photo-electric Amplifier Supplies Power to a Motor which, in Turn, Shifts the Roll of Paper to Maintain Correct Register

Administration is Finding out what the Wagner Act Does to Defense

Many influences in the United States, whether by intent or not, are promoting the success of those ruthless powers that are ready to destroy the type of civilization that our forefathers built up during many centuries of sacrifice and suffering and handed down to us as our most cherished heritage.

Some of the men and women behind these influences masquerade under the colors of patriotism; others, guileless and not comprehending the true meaning of world events, believe that they are promoting the best interests of our country. But there is a third group that, in selfishly serving its own interests at the expense of the nation, serves Hitler and his satellites better than either of the other two. This group consists of men, who, under the pretext of benefiting the industrial workers, deliberately plan stoppage of work on materials needed for the defense of all that we treasure in civilized life.

Is there Any Better Way to Serve Hitler than This?

The labor leaders who, unmindful of the consequences, order men to stop work on defense material, and the men who deliberately vote to go on strike, are Hitler's most valued allies in this country, even though they may have no direct intention of aiding him. It is one thing to use the power of the strike to obtain concessions in time of peace; it is quite another thing to use this weapon at a time when all the self-governing nations of the world, including our own, are seriously threatened. Does it seem reasonable to have young men drafted to serve in the Army, sometimes at great personal sacrifice, while other groups use the national emergency to gain special privileges for themselves?

Under the conditions that this nation is now facing, no one has the right to expect to be able to enjoy all the privileges and comforts that may have been ours in peacetime. No group should expect to benefit by this world calamity. With the heavy taxes in prospect, certainly neither manufacturing concerns, nor men and women with medium incomes, will find this war profitable. Are labor leaders expecting to make it profitable for one class only? Or is their chief aim to increase their own power?

No Group Should Expect to Benefit when Nation is Threatened

At last the President has taken some measures designed to prevent organized efforts to slow up war material production—measures to partially, at least, remedy a situation that has been caused by the one-sided Wagner Act. It was high time for action; it now remains to be seen if these measures, which unfortunately side-step the real issue, will prove effective.

A heavy share of the responsibility for this serious situation rests on the Administration itself. Had moderate steps been taken in time, such drastic measures as have been adopted might have been unnecessary. When Congress became alarmed a few months ago, Mr. Hillman, Secretary Perkins, and the President himself joined in assurances that the situation was not serious, and figures were quoted by the Administration to show how relatively unimportant these strikes were in their effect on defense production.

The real trouble, however, lies not in the complacent attitude of the last few months, but in the labor policy of the Administration for years past. The Wagner Act is at the bottom of the trouble. It assumes that in the relations of employer and employe all the wrongs are on one side and all the rights on the other. The only unfair practices forbidden, or even mentioned, in that Act are practices by employers. The Act mentions coercion on the part of the employer; but it does not mention coercion or violence on the part of union officials or members. As the *New York Times* aptly puts it, "the Labor Board must remain officially blind to the existence of such coercion."

The One-Sided Wagner Act is the Cause of This Trouble

At last it appears as if the Administration had recognized that its past labor policy is a serious menace to the national welfare because it encourages strikes in plants making defense material. Ultimately, an aroused public opinion has forced the President to take drastic action in reopening plants closed by strikes. The Administration's policies of favoring one class as against another has brought the results to be expected. It remains to be seen if the wrong will be corrected, not by such methods as taking over plants from their owners, but by legislation that will hold the unscrupulous labor leader responsible for conspiracy to hold up the nation's defense effort.

Ingenious Mechanical Movements

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

Mechanism for Obtaining Irregular Rotating Movement

By L. KASPER

A machine for fabricating a wire product has two spindles that perform twisting operations in synchronism through approximately half of the operating cycle. During the remainder of the cycle, it is necessary for one of the spindles to accelerate its speed of rotation or to advance ahead of the other, returning to synchronous operation after a specified point in the cycle has been passed. The mechanism developed to obtain the necessary movement is shown in Figs. 1 and 2.

Referring to Fig. 1, gears *B* and *D* are driven by pinion *C*, rotating in the direction indicated by the arrows. Gear *D* is keyed to shaft *K*, while gear *B* is free on shaft *A*. Shaft *A* is supported in bearing *L*, which has a flange on one side on which cam *H* is mounted. Lever *E* is keyed to shaft *A*, and carries at its upper end the shaft *M* to which lever *F* and pinion *J* are keyed.

Lever *F* carries roller *G*, which rolls on cam *H*. Pinion *J* meshes with gear segment *I*, which is carried on, and rotates with, gear *B*. The boss on the upper end of lever *E* is extended to pass through the slot in gear *B*, as shown.

In operation, the rotation of pinion *C* is transmitted to gears *B* and *D*, which rotate in synchronism at a uniform rate. As gear *D* is keyed to shaft *K*, the latter rotates with it. Gear *B*, however, not being keyed to shaft *A*, does not transmit motion directly to shaft *A*. As shown in Fig. 1, the extended boss of lever *E* is in contact with one end of the slot in gear *B;* thus the motion of gear *B* is transmitted to shaft *A* through lever *E* in the direction indicated by the arrow, the effect being the same as though shaft *A* were driven directly by gear *B*.

Referring now to Fig. 2, in which bearing *L* is cut away to expose lever *F*, the rotation of gear *B* has caused roller *G* to rise to the high point of cam *H* and begin descending the other side of the cam. When roller *G* begins to ascend the rise of cam *H*, a rotative motion is imparted to pinion *J* through lever *F* and shaft *M*. This rotative motion of pinion *J*, which is in mesh with gear segment *I*, causes a slow rotative motion to be imparted to lever *E* in the same direction as the

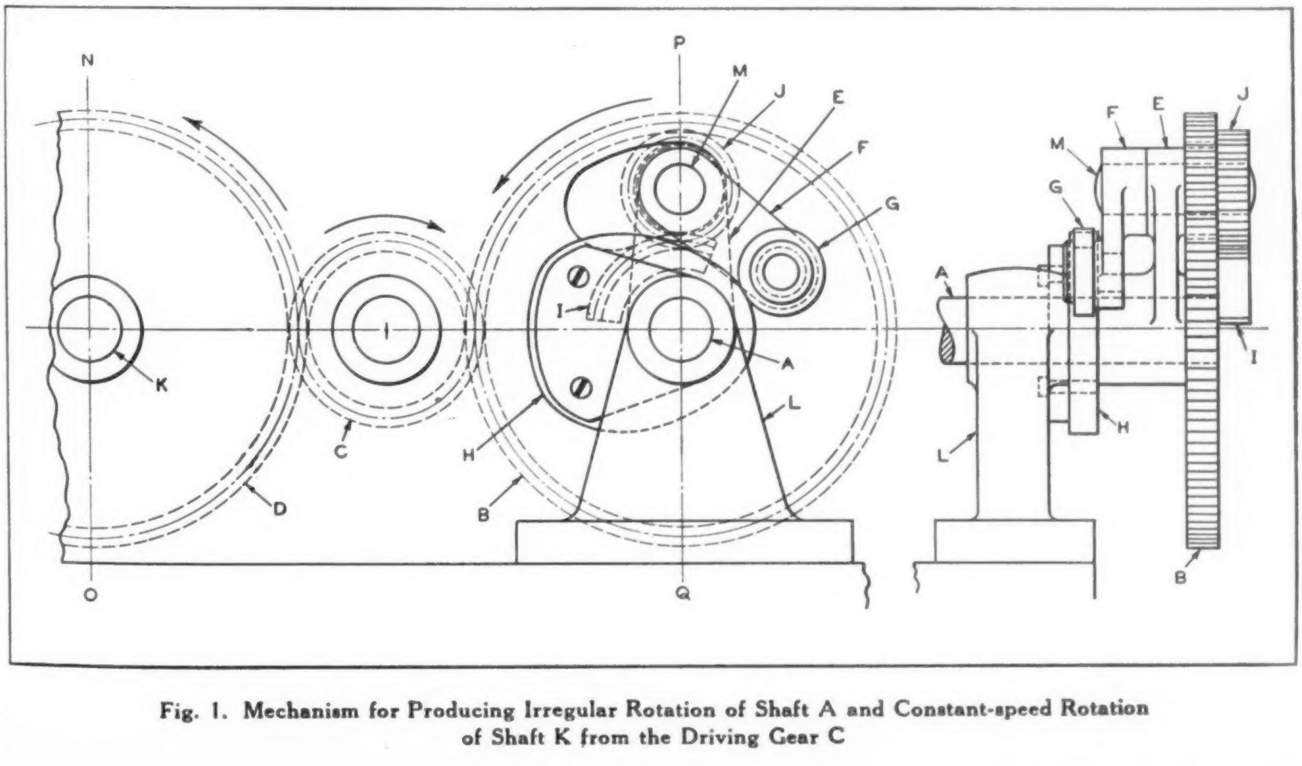


Fig. 1. Mechanism for Producing Irregular Rotation of Shaft A and Constant-speed Rotation of Shaft K from the Driving Gear C

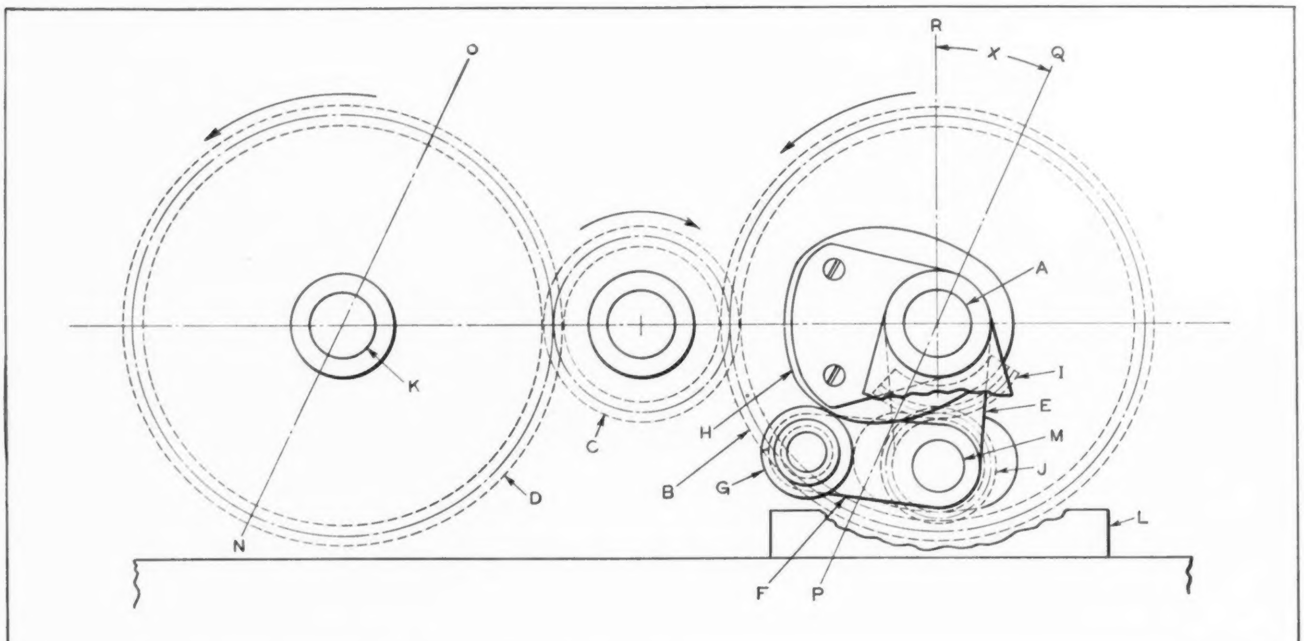


Fig. 2. Diagram Showing Mechanism in Fig. 1 after Shaft A has Rotated 180 Degrees

driving motion transmitted to gear *B*. As lever *E* is keyed to shaft *A*, any movement of *E* causes a change in the relative positions of gear *B* and shaft *A*.

When roller *G* reaches the high point of cam *H*, the entire assembly again rotates as a unit, their relative positions remaining unchanged until roller *G* begins to descend to the low point of cam *H*. In effect, shaft *A* is first given an accelerated movement, because the motion imparted by lever *E* is added to that imparted by gear *B*. The accelerated movement of shaft *A* is followed by a decelerated movement due to the reverse motion of gear *J* when lever *E* is returning to its original position.

The frictional resistance of the assembly, as used on the machine, combined with the resistance of the twisting operation, is sufficient to maintain contact of roller *G* with cam *H;* at high speeds, however, it may be necessary to attach a spring to lever *F* to maintain contact of the roller and cam.

In Fig. 1, the perpendicular radial center lines *NO* and *PQ* indicate the relative positions of gears *B* and *D*, and of lever *E*. In Fig. 2, center lines *NO* and *PQ* indicate that gears *B* and *D* have rotated approximately 150 degrees in synchronism. Center line *R*, through lever *E*, however, indicates a rotation of 180 degrees of lever *E*, the angular advance of shaft *A* relative to gear *B* being indicated by angle *X*.

Steel Fabricated on Building Site for Welded Factory

The Canadian Lincoln Electric Co., Leaside, Ontario, a subsidiary of the Lincoln Electric Co., Cleveland, Ohio, has just completed an entirely welded industrial plant, 100 by 300 feet. In the erection of this plant, the structural steel was fabricated at the building site, thus eliminating many delays. The original intention was to fabricate all steel in a structural shop, but unforeseen conditions made it necessary to move all the steel to the building site and fabricate it there. This fabrication became a simple matter through the use of modern cutting and welding equipment.

Fabrication of steel in the field, which has been shown to be entirely feasible in the case of this building, is also applicable in the construction of bridges and other structures, especially at the present time, when war priorities make it impossible to obtain fabricated steel in a reasonable time. Cutting and welding may also be of importance for military purposes, as, for example, in the rapid construction of temporary bridges and buildings of many types.

* * *

Output of Industrial Gears

The American Gear Manufacturers Association reports that industrial gear sales for May, this year, were more than double those for May, 1940, although they fell 7 per cent below the sales for April, 1941. The sales for the five months ending with May, 1941, were 123 per cent above the sales for the corresponding period of 1940. These figures apply only to industrial gears; they do not include automotive gears or gears used in high-speed turbine drives.

Oxy-Acetylene Flame-Hardening

By L. D. JENNINGS, Generator Works
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

FLAME-HARDENING is a process in which the heat of an oxy-acetylene flame is employed to quickly raise the surface temperature of hardenable ferrous alloys above their lower critical point, after which a suitable quench is applied to secure the desired hardness. It is recognized as a practical selective hardening method for large castings, structures, and machine parts that must be finish-machined prior to heat-treating, or that, because of their size and shape, cannot be successfully heat-treated by the use of a furnace in the conventional way.

The process produces a layer of hardened material varying in depth from a mere skin to 1/4 inch, and with a hardness of 400 to 700 Brinell. This skin is not a casehardened surface, and should not be confused with processes that require the addition or absorption of other elements, such as carburizing, cyaniding, and nitriding. These processes require prolonged heating in special furnaces at high temperatures, which is often prohibitive because of the size and the shape of the part, and is frequently impractical due to the expensive straightening and machining operations necessary to correct distortion from the long heating cycle at elevated temperatures.

The hardened surface obtained with the flame-hardening process is the result of the new structural arrangement of the alloy, and is not due to any chemical change in the material. The oxy-acetylene gas is not a carburizing material, and the flame, when properly adjusted, is neutral. This is a valuable characteristic, as the hardened surface will be clean and free from scaling or pitting.

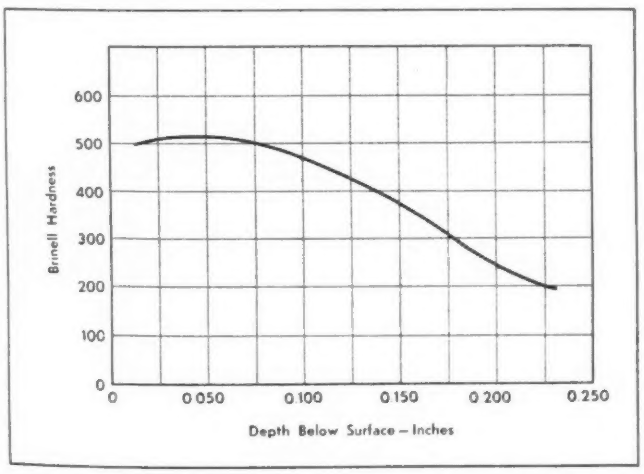


Fig. 1. Curve Showing Variation of Hardness with Depth below Surface after Flame-hardening S A E 1040 Steel

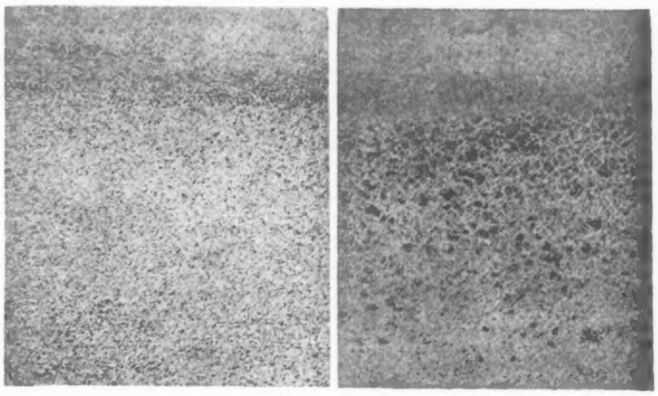


Fig. 2. Sections of Flame-hardened S A E 1040 Steel (Magnified Seven Diameters). Modified Quench Produces a Fine-grained Core Material (Left). The Coarse-grained Structure (Right) Developed because Too Great a Time Elapsed between Heating and Quenching

Flame-hardening is replacing furnace and batch hardening because it is more economical and better adapted for special applications. The designer can select a material with the desired tensile strength and toughness, and yet secure the required wearing qualities. The process also aids the manufacturer in that the structure can be completely machined prior to hardening with no fear of distorted sections or shrinkage cracks. It is more economical to the heat-treater, as heating time and equipment are reduced to a minimum; for example, it would seem wasteful to heat a 10,000-pound forging to from 1500 to 1550 degrees F. for thirty or forty hours to harden 15 per cent of the surface area, when an acetylene torch will quickly and efficiently harden a local area.

Because of these advantages, flame-hardening has gained favor with the fabricators. Medium-carbon and many low-alloy steels are suitable for hardening. Plain carbon steels ranging from 0.35 to 0.60 per cent carbon will give hardnesses of from 400 to 700 Brinell. Steels in the 0.40 to 0.45 per cent carbon range are preferred, as they have excellent core properties and produce hardnesses of from 400 to 500 Brinell without checking or cracking.

Higher carbon steels will give greater hardnesses, but extreme care must be taken to prevent cracking. This requires careful control of the quenching operation. A fine-grained steel having a McQuaid-En rating of 6 to 8 is preferred for flame-hardening by many fabricators, but a coarse-grained steel is also hardenable. A number of steels

that can be successfully flame-hardened are: S A E 1000, 1300, 3100, 3200, 3300, 4100, 5100, 6100, and Cromansil.

The surface of the hardened layer will possess the greatest hardness, but this hardness remains practically uniform to a depth of 0.75 inch; then it gradually decreases to the hardness of the untreated base metal at a point approximately 1/4 inch below the surface, as shown in the accompanying chart (Fig. 1). The structure of a typical hardened layer of S A E 1040 steel consists of martensite for a depth of about 150 mils; then a zone of martensite plus fine pearlite for about 50 mils; then a band 90 to 100 mils wide of heat-refined pearlite and ferrite before the unaffected core material is reached. Typical examples at low magnification are shown in Fig. 2.

This hardened layer is in a state of high stress because of the volume change experienced during the heating and the rapid quench from this high temperature. The thin shell will be in tension, and these stresses may be of such magnitude that cracking or checking may develop. When the quench is not too severe and the hardness is not too great, these stresses may not affect the quality of the surface; but most authorities recommend tempering or drawing of the hardened surface at temperatures between 200 and 350 degrees F. This treatment may be done in a standard furnace, an oil bath, or with a gas flame. It should follow the hardening process as close as possible.

When large massive structures are being hardened, it may not be necessary to temper the structure if the quench is properly controlled, allowing sufficient heat to remain in the structure to compensate for the lack of tempering.

The flame-hardening process is adaptable to both castings and forgings. The size or shape is not a limiting factor, for if the part is fabricated from material of a suitable analysis, the part can be flame-hardened. Flat sections, circular paths, irregular shapes, and varied combinations of these may be successfully flame-hardened. Gear teeth, lathe ways, pump rods, rest spools, rail ends, conveyor screws, and miscellaneous parts lend themselves to this hardening process.

Flame-Hardening Methods

Flame-hardening may be classified into four general groups.

1. The spinning method. This method is employed on circular objects that can be rotated or spun past a stationary flame. It may be subdivided according to the speed of rotation, as, first, where the part is rotated slowly in front of a stationary flame and the quench is applied immediately after the flame. This method is used on large circular pieces such as track wheels and bearing surfaces. There will be a narrow band of material with lower hardness between adjacent torches if more than one path of the flame is required to harden the surface. There will also be an area of lower hardness where the flame is extinguished. Second, when the work is spun at a speed of 50 to 150 R.P.M. in front of the flame until the entire piece has reached the proper temperature and then quenched as a unit by a cooling spray or ejecting into a cooling bath. This method is applicable for small rollers or pinions.

2. The progressive method. In this method the torch travels along the face of the work while the work remains stationary. It is used to harden lathe ways, gear teeth, and track rails.

3. The stationary, or spot-hardening, method. In this method, the work and torch are both stationary. When the spot to be hardened reaches the quenching temperature, the flame is removed and the quench applied.

4. The combination method. This is a combination of the spinning and progressive methods. It is used for long bearing surfaces. The work rotates slowly past the torch as the torch travels longitudinally across the face of the work at the rate of the torch width per revolution of the work.

The equipment for the stationary method of flame-hardening consists merely of an acetylene torch, an oxyacetylene supply, and a suitable means of quenching; but when the other methods are employed, work-handling tools are essential and specially designed torches are desirable. A lathe is ideally suited for the spinning or combination hardening method, while a planer is adapted for progressive hardening. Production jobs, such as the hardening of gears, require spe-

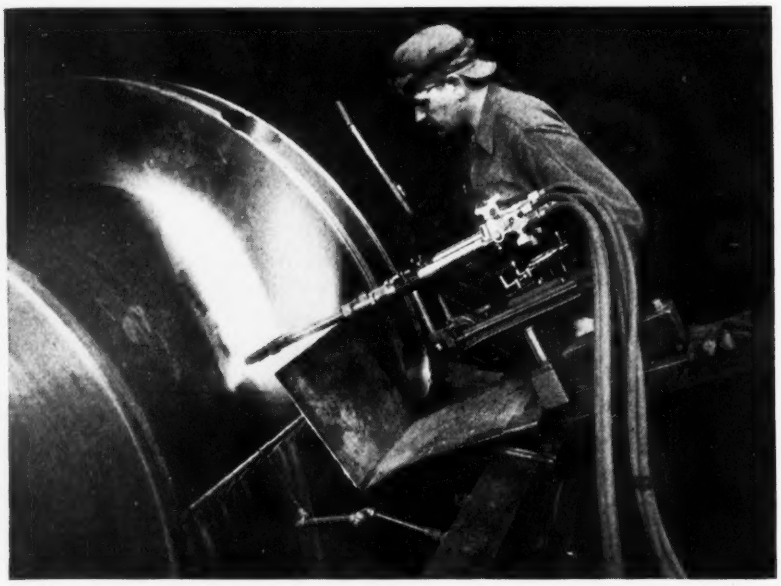


Fig. 3. Flame-hardening the Bearing Surface of a 40,000-pound Lathe Drive Spool. The S A E 1040 Steel is Hardened to 400 to 450 Brinell at the Rate of 7 Inches per Minute in a Path 8 Inches Wide; Four Such Paths are Required

cially designed machines. These machines reduce handling and hardening time, as well as assuring consistent results.

The torch and torch head are of prime importance. The torch is usually of the water-cooled type, while the head is designed for one particular job. The torch head may be flat, circular, or irregular. It is a multi-flame head, and is usually equipped with quenching holes. This type of head will supply a multi-flame path of high heat intensity to quickly raise the surface temperature of the work to be hardened, as well as supply a spray of the quenching medium at a uniform distance behind the flame.

Regulation of oxygen, acetylene, and quenching pressures is of great importance, because these pressures and the speed of travel of the torch along the work are the only means of controlling the hardening process. The pressures must remain constant, and the regulators must have sufficient capacity to permit the passage of the large quantities of gases consumed.

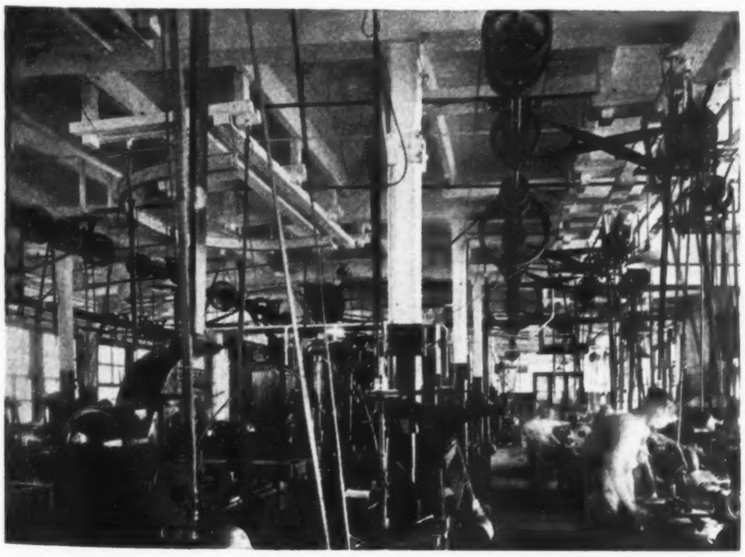
Flame-hardening is gaining favor with the steel fabricator because of its adaptability to special hardening applications with a minimum of equipment. The process is easily controlled, is economical, and gives the work a hardened surface without changing the structure or physical properties of the core material.

* * *

Machinery Exports Remain at High Level

The exports of industrial machinery from the United States during the month of April, the last month for which complete figures are available, were valued at $40,963,000, being slightly in excess of the March figure of $40,418,000. April exports of machine tools, according to the Machinery Division of the Department of Commerce, totalled $19,022,000, as compared with the March shipments of $17,947,000.

A striking example of the "before and after" type of pictures. To the right is shown a Midwest metal-working shop as it appeared before it was provided with a coat of a newly developed, high light-reflecting white paint which is said to reflect nearly 90 per cent artificial or natural light. The other illustration shows the shop after this paint has been sprayed on walls and ceilings. Note that shadows are practically eliminated, due to the fact that the light is reflected from all directions. The available light is also greatly increased. Illustrations are made from unretouched photographs. (Photographs courtesy of the Sherwin-Williams Co.)



Comparison between Different Types of Machines for High Production

In a paper read by Howard B. Cook, of the Wright Aeronautical Corporation, Paterson, N. J., before a meeting of the American Management Association at the Hotel Astor, New York City, on May 21, a comparison was made between the number of machines, the number of operators, and the cost of equipment when different types of machine tools are used for specific machining operations. The figures brought out by Mr. Cook are recorded in the accompanying table, which shows at a glance the number of machines, the number of operators, and the cost of equipment according to the type of machines selected.

Comparison between Number of Machines, Number of Operators, and Cost of Equipment when Different Types of Machines are Used for Identical Operations

Operation	Type of Machines, Number of Operators per Shift, and Cost of Equipment		
Machining Crankcase (Cylinder Pads and Bores)	10 semi-automatics 4 operators $200,000	2 full automatics 1 operator $70,000	
Machining Cylinder Heads	60 hand-operated 58 operators $173,000	40 semi-automatics 35 operators $153,000	2 full automatics 8 operators $230,000 Floor space saved, over 50 per cent
Reaming and Tapping Cylinder Pads on Crankcase	13 hand-operated 13 operators $57,000	1 automatic 1 operator $26,000	
Machining Front Supercharger Housing	8 hand-operated 8 operators $60,000	2 semi-automatics 2 operators $84,000	
Drilling and Back Counterboring Cylinder Hold-down Stud Holes	5 semi-automatics 4 operators $46,000	1 automatic 1 operator $43,000	
Operations on Valve Guide and Seat on Cylinder Head	11 hand-operated 11 operators $36,000	4 semi-automatics 4 operators $60,000	
Milling Oil-groove in Carrier Reduction Gear Pinion	3 hand-operated 3 operators $25,000	1 special 1 operator $11,000	
Turning and Facing Trunnion Arms and Shoulders in Carrier Reduction Gear Pinion	11 hand-operated 11 operators $121,000	2 special 2 operators $16,000	
Facing, Turning, and Boring Reduction Gear or Bell Gear	18 hand-operated 11 operators $284,000	6 semi-automatics 2 operators $96,000	3 special 3 operators $100,000
Machining Magneto and Fuel Pump Shaft	5 semi-automatics 2 operators $50,000	2 automatics 1 operator $30,000	
Machining Reduction Pinion Gear	10 semi-automatics 3 operators $100,000	2 automatics 1 operator $30,000	

Industrial Training Obtained Through Motion Pictures

A motion picture entitled "Passing the Know-How Along" has been produced by the Jam Handy Organization, 2821 E. Grand Blvd., Detroit, Mich., for the purpose of indicating a routine practice to be followed by foremen and workmen in a shop in giving job instruction to learners. It is intended to show men how to teach others in both highly skilled and less highly skilled occupations. The idea behind the picture is that after foremen and other skilled men in the plant have seen the principles of teaching as outlined in operation in the picture, they will have a more comprehensive idea of how to help the learner.

Success of State Trade Schools' Emergency Training Courses

THE state trade schools of Connecticut have long been known for their success in vocational education. In addition to the regular three-year courses offered by these trade schools, they have recently maintained emergency training courses of 400 and 200 actual training hours each, in aircraft, screw machine work, general machine shop, and foundry work. These courses, according to the manufacturers who have employed the young men so trained, have been remarkably successful.

There are eleven of these trade schools throughout the state of Connecticut. The information contained in the following paragraphs refers specifically to the one maintained in Bridgeport, Conn., but similar results are being achieved by the other schools as well. Perhaps the fact that strikes a visitor to the Bridgeport Trade School most forcibly at first is that the school runs on a three-shift, twenty-four hour basis. Generally speaking, the regular three-year courses are conducted during the day from 8 A.M. to 5 P.M. Then so-called pre-employment courses—these are the 400- or 200-hour courses—are given from 5 P.M. to 12 midnight, and others from 12:15 midnight to 7:30 A.M. The fact that the boys are willing to go to school from midnight to early morning to learn a trade disproves the statement that the American boy is only interested in a white-collar job.

Practical Character of Trade School Instruction

The next thing that is strongly brought home to the visitor to these trade schools is the practical character of the instruction. These are not "school" shops in the ordinary sense of that word. They are production shops. The work done is actual production work on parts furnished by manufacturers in the vicinity. Thus, from the very beginning, the boy recognizes that he is doing something useful and that it must be done right. School work takes on a new dignity, and, besides, the boys learn that their work is actually productive in the present emergency.

Another interesting fact is that most if not all the boys in these emergency training courses have practically been hired by their future employers before they start their training. In this way, wasted effort in training boys who later will be unable to find employment is avoided. The boys wishing to enter the emergency training courses first register at the local State Employment Office, where they are interviewed and given the standardized tests for mechanical aptitude. They next go to the employment office of the manufacturer who may wish to employ them, and if they are told that, provided they finish the training course satisfactorily, they can come to work, they are accepted by the school for pre-employment training. Then when the boy has finished his course satisfactorily, he goes back to the shop employment office with the required credentials and starts working as a mechanic. Obviously, in 200 hours it is not possible to teach a boy a trade; but he can acquire a general conception of machine shop practice, and in cases where he specializes in, say, hand screw machine work, he can become sufficiently trained to handle a machine on simple production work.

Now as to the results: Out of 589 graduates of the 400-hour aircraft courses, the records show that only four were not able to hold their jobs in the manufacturing plants where they went to work after completing the course. And even in these cases, it was because of their own personal traits rather than because they were not properly trained that the employer considered it inadvisable to retain them. On April 1, this year, there were 653 young men enrolled in the various emergency courses. Previous to that time, over 800 had been placed in industry. Obviously, a certain number drop out of the courses during the training period, some because they may not show fitness for the work, and some because of defective eyesight.

In the general machine shop course, everyone who has completed the course has been placed with a manufacturer, except one student who did not take the course with the intention of receiving employment, but merely for the mechanical training. In all the other pre-employment courses, every graduate has been placed in industry. Of those trained in machine shop work, the Bullard Co., the Vought-Sikorsky Co., and the Manning, Maxwell & Moore Co., have absorbed the greatest number. These companies have informed the trade school that they are highly pleased with the results obtained from the work of these young men.

One difficulty in starting these educational training courses is obviously that of finding competent instructors. This problem has been solved by the cooperation of industry with the trade school. The companies mentioned have temporarily lent to the school competent instructors—men who are mechanics with many years of experience. In this way, the closest relationship between the immediate needs of industry and the facilities of the school for training has been maintained.

What the Connecticut State Trade Schools have done, every state with highly developed industries

could do. Cooperation between industry and the school system, however, is of prime importance. If the school system is dominated by purely academic influences, as is sometimes the case, satisfactory results cannot be obtained; but when, as in Connecticut, the highest authorities in the Department of Education have a clear conception of the importance of vocational education and the results that can be obtained through properly organized schools, educational authorities and industrial leaders can work in close cooperation toward successful results.

To All Americans Who Have Not Been Drafted

EACH day as the sun goes down, it is setting not only on your home and mine, but on scores of army camps, naval stations, and defense outposts. It will set on one and a half million young men in uniform. Most of them will be far from home. Many of them will be in places remote from towns and cities. What their life will be like after the sun goes down depends largely on you and me.

These men need clubs; they need places where they can go for recreation and comfort in the evening; they need places where they can rest and relax and find good companionship; places where they can get help and advice if they want it.

To provide such service clubs, six of America's most experienced organizations in work of this character have joined to form the United Service Organizations for National Defense. These organizations are the Y.M.C.A., the National Catholic Community Service, the Salvation Army, the Y.W.C.A., the Jewish Welfare Board, and the National Traveler's Aid Association.

The United Service Organizations will set up more than 360 of these clubs. The Government will supply the buildings, but to the American public belongs the responsibility of running them and financing them. The cost for the first year is estimated to be slightly in excess of $10,000,000. Here is the opportunity for you and me, who have not been drafted; here is the chance for us to do a small part to aid in national defense. We who have not been drafted, should we not spare a small part of our earnings to make life more pleasant for those who have been? If so, let us join the army behind the army.

Contributions—small or large—may be sent to the local headquarters of any of the organizations mentioned or to the headquarters of the United Service Organizations, Empire State Bldg., New York.

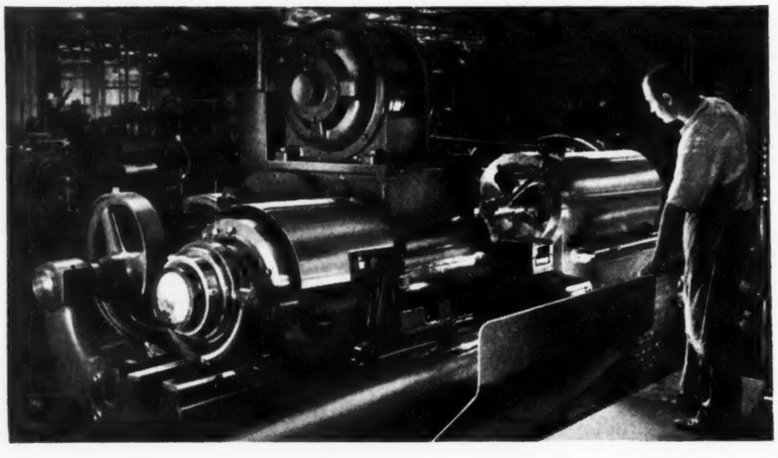
* * *

Willys-Overland Plans to Produce Aluminum Forgings

Large-scale production of aluminum forgings for military aircraft construction will be started by Willys-Overland Motors, Inc., Toledo, Ohio, in the fall. The Willys-Overland forge shop is now being converted to aluminum forging production. The capacity is estimated at 40,000 pounds of forgings a day. The plant will have more hammers than any other aluminum forge shop in the country, except the huge forge shop in Cleveland, Ohio, of the Aluminum Co. of America.

* * *

Government ought to take lessons from the American railroads in their attainment of greater efficiency under conditions that make for economy. Railroad costs have mounted greatly in the last twenty years, but private management has learned to cut its cloth to fit the pattern.—*Charleston (S.C.) News and Courier*



A Cleveland Automatic of Huge Proportions Operating on Parts for Hamilton Propellers. This Machine has a Capacity for Operating on Tubing Held in a Chuck up to 9 3/4 Inches in Diameter, and on Bar Stock up to 8 Inches in Diameter. It is Driven by a 20-H.P. Motor

Ingenious Plan for Operating Plants Seven Days a Week

RESPONDING to the President's request that all machine equipment used for producing war material be operated twenty-four hours a day, seven days a week, many manufacturers have given thought to methods by means of which this can be accomplished. A company in the machinery field has evolved a plan that enables the plant to run seven days a week, and yet requires each operator to work, on an average, only the same number of hours a week that he formerly did. This plan might be of general interest, and is, therefore, briefly outlined here. By slight modifications, the basic idea can be applied to almost any plant or department of a plant.

The former practice was to operate two shifts ten hours a day for five and one-half days a week, each employe on the day shift working five full days and Saturday morning, while each employe on the night shift worked five full nights, beginning Monday night, and Saturday afternoon.

Under the new plan, each employe is assigned to one of eight groups designated A, B, etc. A monthly calendar card is laid out as shown in the accompanying illustration. Each employe works on days when his group letter does *not* appear on the calendar. By examining the calendar, it will be noted that each employe works for six consecutive days and then has two days off. For example, a man in group A worked from Monday to Saturday (June 2 to 7, inclusive), and then had Sunday and Monday, June 8 and 9, off; the next week he had Monday and Tuesday off; and so forth.

In order to put the plan into effect, the hours of operation per shift were increased from ten to ten and one-half hours per day, so that each employe averages fifty-five hours a week, the same as by the former two-shift plan. To get the full benefit of the plan, it is necessary to hire 25 per cent more men, so that the man-hours per week are increased 25 per cent. However, immediately after changing to the new schedule and before hiring additional men, the man-hours will remain the same, so that there is no loss in production while changing from one system to the other.

In assigning men to groups, it is merely necessary to ascertain that the operators of each type of machine are in different groups, so that when a man is out in group A, there will be an operator in groups B, C, D, E, F, or G available to run his machine. The only place where difficulty would be encountered is in a department with less than six operators. Then, if some operators are able to run two or more types of machines, it is still possible to adopt the system.

It should be noted that, under the new schedule, each employe has, on an average, seven full days off in four weeks, while under the former system, he has four full days and four half-days.

The older men (who are especially valuable to the company), together with their families, like the new plan, as they have two full consecutive days off, sometimes in the middle of the week, allowing them to take camping trips or trips to the seashore without having to drive in Sunday traffic. The younger men, again, prefer their time off on Saturday and Sunday because their friends usually work during the week and have the week-end off.

In any event, this system is one solution to the problem and is worth considering. It treats all employes alike, and no one group or shift has to make all the sacrifices.

* * *

Business as Usual

Ignoring bombs and "blitzes," the International Meehanite Research Institute held its annual meeting in London, June 16 and 17. Representatives from nineteen Meehanite foundries in Great Britain were present, and numerous research papers were presented and discussed.

JUNE						
SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
A E 1	B E 2	B F 3	C F 4	C G 5	D G 6	D H 7
A H 8	A E 9	B E 10	B F 11	C F 12	C G 13	D G 14
D H 15	A H 16	A E 17	B E 18	B F 19	C F 20	C G 21
D G 22	D H 23	A H 24	A E 25	B E 26	B F 27	C F 28
C G 29	D G 30					

Monthly Calendar Card Showing Days when Each Group is Not Working

Service and Information Office in Washington

THE Department of Commerce, Washington, D. C., has established a Service and Information Office in Room 1060, Department of Commerce Building, to assist manufacturers and business men in obtaining specific information on how to proceed in supplying materials to the Army, Navy, and other governmental agencies.

Many manufacturers have felt that if they desired to transact business with the Government, they must either go to Washington in person or employ someone familiar with government purchasing methods. Those in charge of the newly formed Service and Information Office strongly urge manufacturers not to come to Washington—at least not until they have carried on preliminary negotiations by mail with the purchasing agency that handles their particular product. They are also advised not to employ outsiders on a commission or other basis; in fact, the War and Navy Departments and the Office of Production Management have repeatedly warned against the employment of what are termed "lobbyists" in the effort to obtain government contracts. Furthermore, the Army has so decentralized its purchasing system that only a very small percentage of Army supplies is purchased in Washington. Large groups of Army requirements are purchased by offices in Philadelphia, Pa., Boston, Mass., and Dayton, Ohio. The Navy, as well, has decentralized part of its purchasing system, and prefers to conduct the preliminary negotiations by mail.

When it is necessary for a manufacturer to go to Washington, the Service and Information Office will arrange for him to see the particular official with whom contact should be made, in order that manufacturers may be able to transact their business in Washington with the minimum of time, effort, and expense.

Rapid Construction of Large Press Made Possible by Arc Welding

THE construction of a 700-ton metal-forming press within a period of thirty-five days from the inception of the idea to the actual operation of the machine might well be claimed a record. More important, however, is the fact that it provides a tangible indication of what might be done in certain types of machine construction to circumvent "bottlenecks" and speed the Defense Program.

This press, shown in Figs. 1 and 2, was designed exclusively for arc-welded construction by R. G. LeTourneau, Inc., Toccoa, Ga. It was built for the company's own use in the forming of standard 4-

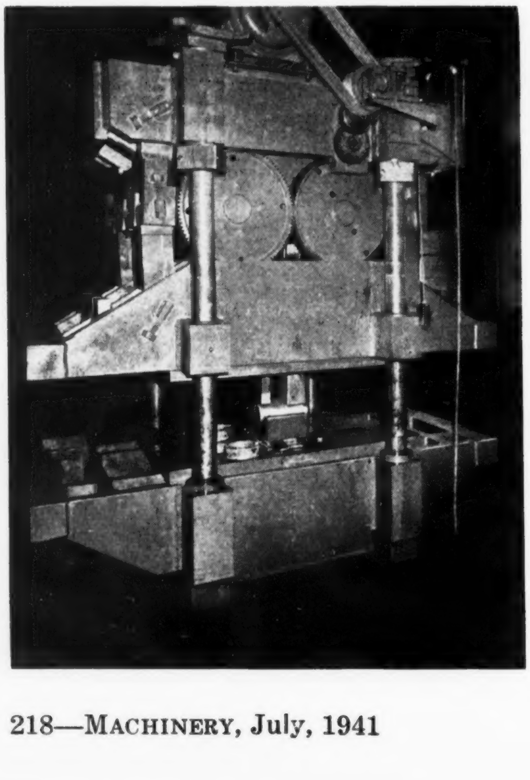


Fig. 1. (Left) 700-ton Metal-forming Press Fabricated by Arc Welding in Thirty-five Working Days

Fig. 2. (Right) Side View of Press Constructed by Arc-welding Heavy Steel Plates, Billets, and Blooms

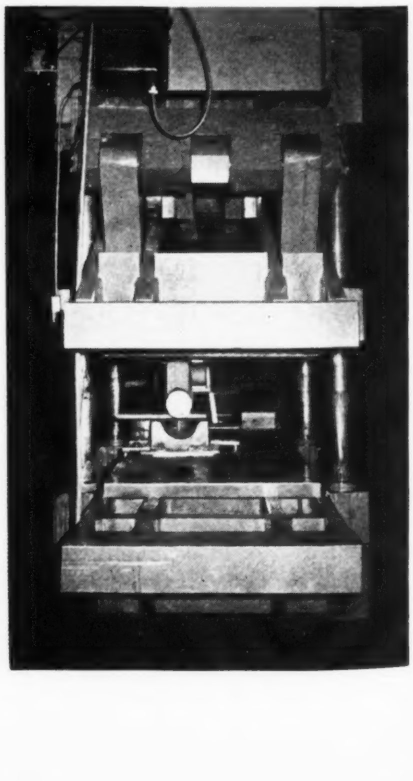


Fig. 3. Machining the Crown of the Metal-forming Press

by 8-foot panels utilized in the construction of all-steel arc-welded houses. The shielded-arc process of welding was employed with equipment manufactured by the Lincoln Electric Co.

Using modern arc-welding and flame-cutting equipment, combined with wide experience in this type of construction, the actual building of the press was not found to be a difficult undertaking. It was simply a case of working out the design of welded construction, cutting the parts from standard plate and shapes, and then assembling these parts by welding.

Some idea of the size of the pieces used may be gained from Fig. 3, which shows the machining of the massive crown of the press. The blooms used for the slide guides are 8 inches square, while the plate used in the remainder of the structure is 3 inches thick.

Proper procedure control for welding, efficient positioning equipment developed by the builder, and special methods of controlling expansion and contraction, together with the use of modern electrodes and welding machinery, made this unusual feat possible. Four welders and one set-up man welded the entire press structure in three and one-half days. Even the gears used in the drive of the press, as shown in Fig. 4, are fabricated by welding.

* * *

A large equipment manufacturer has adopted 3 1/2 per cent nickel-molybdenum casehardening steel to replace lower alloy steels in rock-bit cutters.

Defense Production Getting Under Way

As an indication of how industry is getting into the stride of producing equipment for national defense, it is of interest to note that the White Motor Co., Cleveland, Ohio, finished its order for scout cars nearly five months ahead of schedule, and recently started on a still larger order for what are known as "Half-Tracs." These are armored cars for reconnaissance work, of which the White company will build more than 5000. The "Half-Tracs" may be defined as a cross between a truck and a caterpillar tractor. They are capable of a speed of 50 miles an hour over smooth ground, but are designed to operate efficiently also over soft and broken terrain. In front they have ordinary rubber-tired wheels; but instead of having regular rear wheels, the rear end of the car is supported by an endless belt track which is driven by the forward axle of the rear bogie. This gives the car greater traction power on soft or broken ground. At the same time, power is applied to the front wheels, so that the driving force is applied both at the front and at the rear. These cars are covered with 1/4-inch armor plate for protection against rifle or machine gun bullets.

* * *

The machine tool shipments for May by machine tool manufacturers in the United States are estimated at $60,800,000, compared to $60,300,000 for April, and $57,400,000 for March, this year. Shipments for May a year ago were estimated at $32,800,000. The annual production rate, based on the May, 1941, shipments, is approximately $730,000,000.

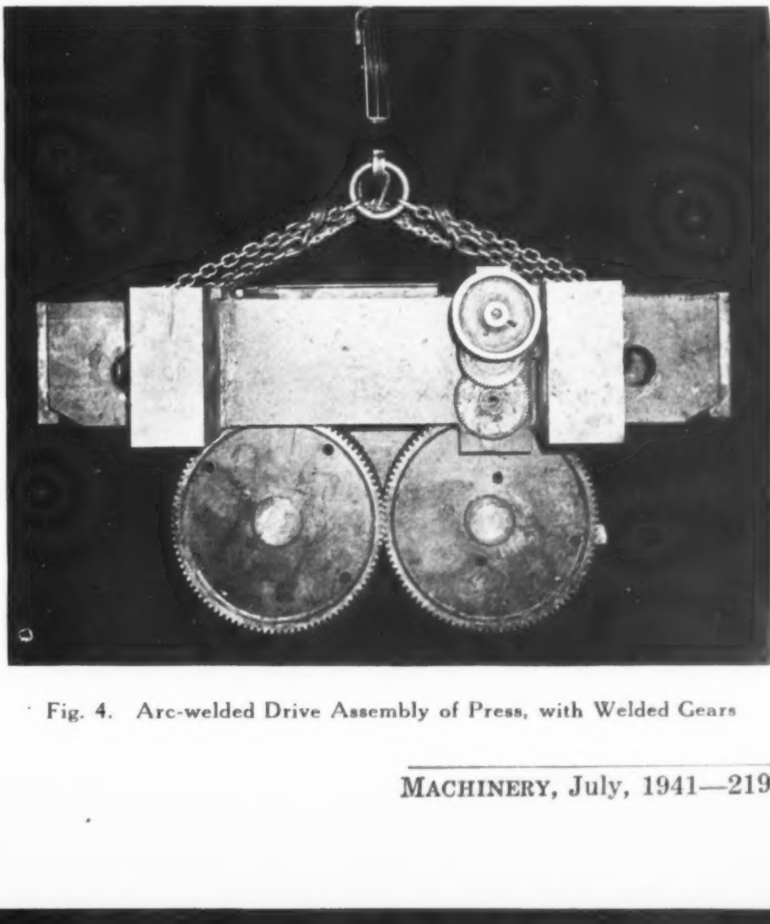
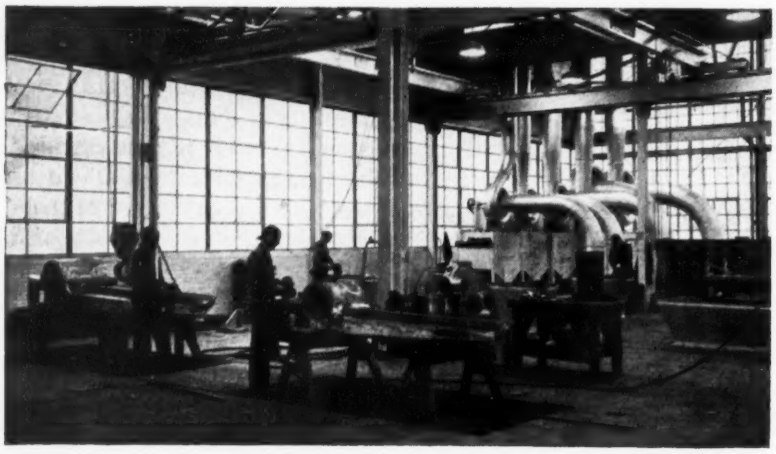
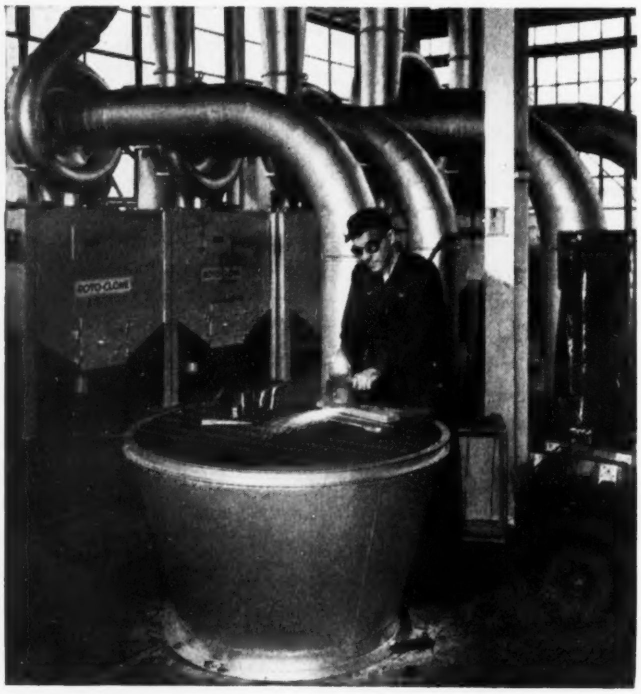


Fig. 4. Arc-welded Drive Assembly of Press, with Welded Gears

Pure Air in Casting Cleaning, Grinding and Painting Room



The Larger Castings are Cleaned by Grinding them over Down-draft Grille Openings in the Floor, as Shown in the Illustration at the Left, while Medium Castings are Ground over a Pedestal Grille, as Seen in the Center Illustration

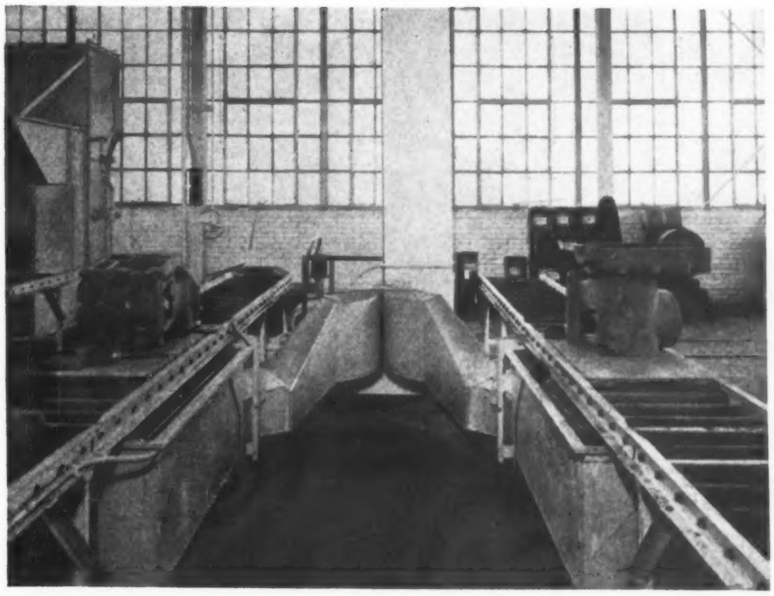


EQUIPMENT and methods are now available that make it possible to maintain the air in a sanding, grinding, filling, and painting department just as clean and fresh as it would be in an office or in a home. A recent addition to the plant of the Cincinnati Bickford Tool Co., Cincinnati, Ohio, provides a striking demonstration of this statement. Through the provision of down-draft systems for carrying off dust and sand particles, water-wash spray booths, and air-purifying equipment, clean fresh air is maintained at all times, the air in the shop being completely changed every seven minutes.

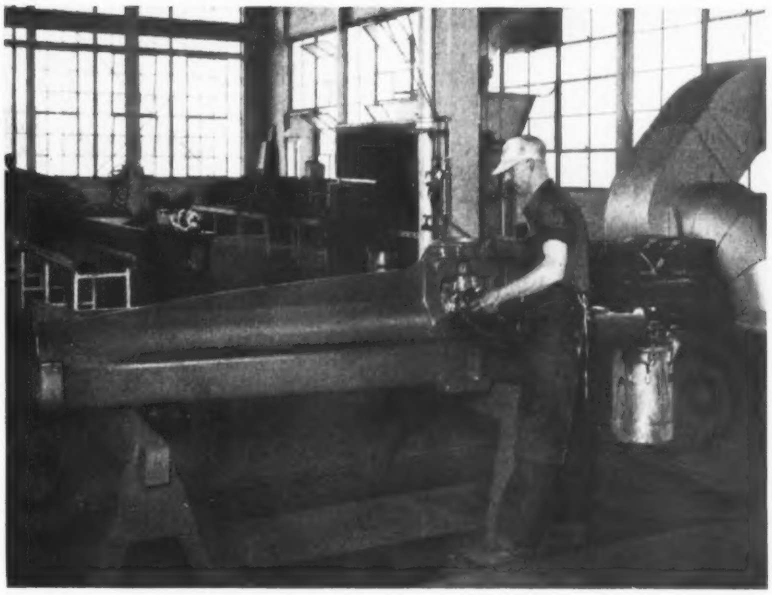
When cleaning, the castings are placed over grilles—large castings over grilles in the floor and medium-sized ones over pedestal grilles. Small castings are cleaned at a bench where separate exhaust outlets are provided for each working position. In the paint department, much of the work is done in front of a water-wash spray booth, the water carrying off the excess paint. A system of conveyors and transfer tables provides for easy handling of the work.

Small Castings are Cleaned at a Bench where Sand and Dust are Carried off by Separate Exhaust Outlets Provided for Each Working Position in Order to Insure Clean Air

Medium and Small Castings are Filled and Sanded on Conveyors under which there are Down-draft Grilles. From the Conveyors, the Castings Pass to a Paint Booth

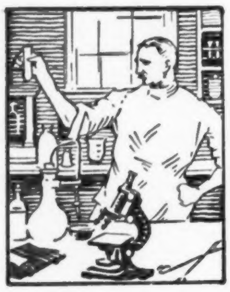


Large Castings are Spray-painted over Floor Grilles with a Water Screen below the Floor to Remove All Paint Particles, while the Fumes are Exhausted Outside of the Building



Medium and Small Castings are Painted in Front of a Water-wash Spray Booth, where a Continuous Sheet of Water behind the Object being Sprayed Carries off the Excess Paint

MATERIALS OF INDUSTRY



THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

Plastics Developed to Replace Aluminum

Efforts to replace aluminum with plastics are everywhere in evidence. The General Electric Plastics Department, Pittsfield, Mass., has developed a plastic pulley sheave. The first application is on a wire-enameling machine installed at the Pittsfield plant. A sheave 8 inches in diameter is used in this case, but plastics are adaptable to larger or smaller sizes. This sheave is made from molded laminated Textolite; while it is light in weight, it has all the necessary properties for the use made of it. In the wire-enameling machine, the plastic sheave has several advantages over a metal sheave. It does not pick up the coating from the wire, and therefore no sediment is left in the groove, as was the case with an aluminum pulley. Another feature is that the plastic sheave does not become hot in operation, thus reducing the need for lubrication. 201

Blackening Process for Zinc and its Alloys

A new immersion process for the blackening of zinc and its alloys has been developed by the Enthone Co., 442 Elm St., New Haven, Conn. This process, called "Ebonol Z," consists of immersing the zinc or zinc alloy in a solution of Ebonol Z salts at a temperature of 150 to 212 degrees F. An adherent jet black inorganic finish is formed in from one to five minutes. The work is cleaned in alkaline cleaners or degreased with solvents and then acid-dipped, similarly to preparing work for plating, before being treated in the blackening solution. According to the manufacturer, one pound of salts will blacken over 150 square feet of zinc surface. The bath is not critical and requires little control.

The Ebonol Z solution can be used for producing a black coating on stainless steel, nickel silver, nickel, and the noble metals by making a couple with these metals and a piece of zinc. This can be done by using a zinc basket or by fastening a sheet of zinc to the rack or basket in which the metals are to be blackened. The process is stated to be particularly valuable for nameplate finishing where recesses are to be blackened, and for blackening of etchings on rules, squares, tools, etc.

It can be used for blackening zinc-plated or hot-galvanized surfaces, as well as for solid zinc or its alloys. The blackening process is stated to be particularly suitable for armament purposes, as it allows the blackening of zinc and other metal surfaces for the purpose of reducing or eliminating glare, and, in addition, the thinness of the coating obviates difficulties from a dimension tolerance standpoint. Unlike plated or enameled coatings, the Ebonol Z coating does not change the thickness of the piece more than a few hundred-thousandths inch; consequently, close dimensions can be maintained. 202

Bi-Metal Tubing that Withstands Severe Corrosive Conditions

Duplex tubing, having an inner tube of one metal or alloy and an outer tube of a different metal, recently introduced by the Bridgeport Brass Co., of Bridgeport, Conn., is rapidly being applied to new uses in many fields where tubing is subjected to two different types of corrosive attack, such as in oil refining and chemical plants and in many processing industries. For applications of this sort, bi-metallic tubing is now manufactured with a combination of metals chosen to meet specific conditions.

For oil refinery work, tubing made of steel outside for corrosive oil vapors and copper inside for circulating fresh water has been found entirely satisfactory or a similar tubing with steel outside for the same conditions and Admiralty brass inside for circulating salt water is also suitable. In chemical plants, Duplex tubing of Admiralty brass outside for circulating brackish water and aluminum inside for certain chemicals is used. In refrigeration plants using ammonia, a combination of steel outside to resist ammonia attack and copper inside to withstand circulating water corrosion has been successful.

In food processing industries, where the foods

To obtain additional information about materials described on this page, see lower part of page 226.

and oils become rancid in ordinary tubing, stainless steel and brass and other combinations have overcome these difficulties. Other combinations successfully used include cupro-nickel outside, red brass inside; stainless steel outside, Admiralty brass inside; and steel outside, Cuzinal (aluminum brass) inside. Many other combinations are available to meet specific conditions.

In construction, a close contact is obtained between the two materials in the composite tube, so that good heat transfer is possible, where this is needed. When Duplex tubes have to be expanded or rolled into a tube sheet, they are supplied with annealed or tempered ends..................203

Vinylite Resins Make Strong Plastic and Metal Adhesives

Two adhesive solutions made of Vinylite resins which produce unusually strong, impact-resistant, metal-to-metal or phenolic-to-phenolic bonds have been placed on the market by the Carbide & Carbon Chemicals Corporation, 30 E. 42nd St., New York City. One of these adhesives, designated XL-5041, consists of a 24.5 per cent solution of a modified polyvinyl acetate in toluol; the other—XL-5075—is a 28 per cent solution of the same resinous material in methyl acetate. Both produce the same strong bonds, but differ in the time required for drying, the XL-5075 adhesive drying considerably faster.

In use on molded phenolic plastics, the surface of the molded part is first cleaned by washing with ethanol or toluol, and the thinned adhesive solution is then roll-coated or sprayed on either one or both of the surfaces to be joined. For adhesion, the parts are placed in position in a jig, pressure is applied, and the assembly is heated, and then cooled under pressure, after which the bonded parts are released.

For bonding laminated phenolics to each other, to molded phenolics, or to metal, the same general procedure is followed. It should be noted, however, that the modified polyvinyl acetate adhesives can only be used after the phenolic bond of the laminate has been cured.

The bond strength of the new Vinylite adhesives is remarkably high. Tension tests of bonded metal parts indicate a shear strength of 6000 pounds per square inch. In addition, the impact strength is better than that obtainable with regular grades of polyvinyl acetate, parts bonded with the modified adhesives being able to withstand sharp blows without injury. 204

Protective Coating for Aluminum Castings

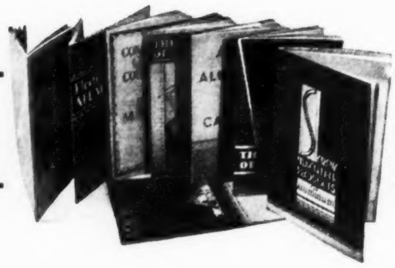
Aluminum castings, especially those subjected to low temperatures, are likely to be attacked by water vapor condensation. A protective coating for such castings is being made by the Glyco Products Co., Inc., 230 King St., Brooklyn, N. Y. This company recommends an emulsion of paraffin wax and Flexo Wax C, made with Diglycol Stearate S, both products of the company. The emulsion can be easily applied to the castings by spraying, leaving a film of water-repellent wax that completely protects the metal. This emulsion has also given satisfactory results on extruded parts, and on zinc- and tin-plated products. 205

New General-Purpose Phenolic Molding Compound

A general-purpose phenolic molding compound known as Durez 775 Black has recently been brought out by Durez Plastics & Chemicals, Inc., Walck Road, North Tonawanda, N. Y. Among the improvements offered by this new compound, compared with other compounds of the general-purpose type, are lower water absorption; slightly higher flexural and tensile strength; and heat resistance of 400 degrees F. It is also stated that Durez 775 Black has excellent molding characteristics, a fast cure, and will deliver a smoother and more lustrous finish than the average general-purpose material. 206

Transparent Plexiglas Model of a Water Meter Produced by the Neptune Meter Co., New York City, for Exhibition Purposes and to Enable Water Supply Engineers to Quickly Examine the Design of the Meter. Except for the Gears and Bearings, the Entire Meter Housing and Fittings are Made from Blocks of Optically Clear Plastic

To obtain additional information about materials described on this page, see lower part of page 226.

NEW TRADE  LITERATURE

Balancing Machines

TINIUS OLSEN TESTING MACHINE Co., 500 N. 12th St., Philadelphia, Pa. Catalogue 19, entitled "Olsen Static and Dynamic Balancing Machines," containing a treatise on the general principles of balancing, and illustrating and describing the machines. Bulletin 14, on the construction and application of Type E0 static and dynamic balancing machines. 1

Tubing Data Chart

REPUBLIC STEEL CORPORATION, STEEL AND TUBES DIVISION, Cleveland, Ohio. Chart giving data on welded tubing, including sizes, tolerances, weights per foot, chemical analyses, etc., of round tubing, as well as of squares and rectangles. The chart is 22 by 14 inches, designed either to be hung on the wall or placed under the glass top of a desk. 2

Aircraft Roller Bearings

SHAFER BEARING CORPORATION, 35 E. Wacker Drive, Chicago, Ill. Bulletin 532, on roller bearings with positive self-alignment, especially designed for aircraft, including rod end bearings, turnbuckle eye bearings, and double-row shielded bearings. This publication should be of particular interest to designers of aircraft. 3

Electric Welding

JAMES F. LINCOLN ARC WELDING FOUNDATION, P. O. Box 5728, Cleveland, Ohio. First issue of new publication "Aspiration," especially featuring the Lincoln $200,000 industrial progress award program, indicating how any man in the mechanical field may participate in this competition. 4

Drilling Machines for Small Holes

TAYLOR MFG. Co., 2330 W. Clybourn St., Milwaukee, Wis. Bulletin 752, entitled "Drill Holes 0.002 Inch Diameter Economically," illustrating and describing sensitive drilling machines with capacities for drilling holes ranging from those of very small diameter up to holes 5/8 inch in diameter. 5

Recent Publications on Machine Shop Equipment, Unit Parts and Materials. To Obtain Copies, Fill in on Form at Bottom of Page 225 the Identifying Number at End of Descriptive Paragraph, or Write Directly to Manufacturer, Mentioning Catalogue Described in the July Number of MACHINERY

Socket Screws

HOLO-KROME SCREW CORPORATION, 1 Brook St., Elmwood, Hartford, Conn. Catalogue of socket set-screws, socket-head cap-screws, and socket screw keys, together with formulas for determining all dimensions, screw thread data, and thread and body length tolerances. 6

Cutting and Grinding Compounds

OAKITE PRODUCTS, INC., 26 Thames St., New York City. Booklet on cutting and grinding compounds, giving fifty-three different formulas for compounds suitable to use in machining various types of metals and in different kinds of machining operations. 7

Air Cylinders

HANNA ENGINEERING WORKS, 1765 Elston Ave., Chicago, Ill. Catalogue 230, on Hanna cylinders for power movement in any direction, applicable to presses, shears, clutches, brakes, furnace doors, material-handling equipment, fixtures, hoists, etc. 8

High-Pressure Pumps

BALDWIN SOUTHWARK DIVISION OF THE BALDWIN LOCOMOTIVE WORKS, Philadelphia, Pa. Bulletin 106, on high-pressure hydraulic pumps designed to handle large volumes of water in conjunction with hydraulic press installations. 9

Molybdenum High-Speed Steel

CRUCIBLE STEEL CO. OF AMERICA, 405 Lexington Ave., New York City. Three booklets on molybdenum high-speed steels covering, respectively, Rex MM, Rex VM, and Rex TMO steels, all of which are suitable as substitutes for tungsten high-speed steels. 10

Lubrication

SUN OIL CO., Philadelphia, Pa. Folder entitled "P-Q, Your Key to Increased Production," calling attention to the importance of proper lubricating and cutting oils in obtaining the highest possible production. 11

Precision Laying-Out Equipment

DAYTON ROGERS MFG. Co., 2830 S. Thirteenth Ave., Minneapolis, Minn. Bulletin describing the precision combination "Angle Plate-Holocator," a toolmaker's device for drilling, locating, measuring, laying out, and checking. 12

Welding Controls

WESTINGHOUSE ELECTRIC & MFG. Co., East Pittsburgh, Pa. Folder 26-210, on welding circuit control panels with basic ratings up to 300 amperes for use with constant potential multiple-operator welding systems. 13

Ball Bearings

NEW DEPARTURE DIVISION, GENERAL MOTORS CORPORATION, Bristol, Conn. Shop Manual containing information on ball-bearing mounting and maintenance practice, profusely illustrated, including detailed instructions. 14

High-Speed Production Tools

ILLINOIS TOOL WORKS, 2501 N. Keeler Ave., Chicago, Ill. Circular entitled "Extra Life for Transmission Gears," describing how this company helped to solve a problem in gear-tooth design. 15

Vibration Control

LORD MFG. Co., Erie, Pa. Bulletin 104, entitled "Vibration Control—Lord Bonded Rubber Shear-Type Mountings," giving complete information on vibration isolation by rubber mountings. 16

Steel for Plastic and Die-Casting Molds

JESSOP STEEL Co., Washington, Pa. Bulletin 241, on Jessop "Press E-Z" hobbing steel for making molds for plastics and die-castings by the hobsinking method. 17

Flexible Couplings

D. O. JAMES MFG. Co., 1120 W. Monroe St., Chicago, Ill. Catalogue 33, covering design and construction features of three types of flexible couplings for industrial requirements. 18

Threading Machines, Die-Heads and Collapsible Taps

LANDIS MACHINE Co., Waynesboro, Pa. Bulletin covering the company's entire line of threading machines, die-heads, and collapsible taps. 19

Precision Cutter Grinders

GENERAL MACHINERY CORPORATION, 140 Federal St., Boston, Mass. Circular descriptive of the Barnes precision cutter grinder for grinding formed and other cutters. 20

Electric Grinders, Drills, Etc.

STANDARD ELECTRICAL TOOL Co., 1948 W. 8th St., Cincinnati, Ohio. Catalogue 43, illustrating and describing this company's line of electric grinders, buffers, and drills. 21

Fittings and Tubing

IMPERIAL BRASS MFG. Co., 1200 W. Harrison St., Chicago, Ill. Bulletin 3101, illustrating and describing Imperial fittings and tubing for eliminating failures from vibration or tube movement. 22

Electric Hoists

AMERICAN ENGINEERING Co., 2435 Aramingo Ave., Philadelphia, Pa. Catalogue H-40, descriptive of the construction, operation, and application of "Lo-Hed" monorail electric hoists. 23

Adjustable-Speed Drives

WESTINGHOUSE ELECTRIC & MFG. Co., East Pittsburgh, Pa. Bulletin DD-4063, describing alternating-current adjustable-speed drives ranging from 1 to 15 H.P. 24

Deep-Hole Drilling Machine

MOREY MACHINERY Co., INC., 410 Broome St., New York City. Circular 717, containing specifications covering the Morey duplex horizontal deep-hole drilling machine. 25

Tool Chests

GEORGE SCHERR Co., INC., 128 Lafayette St., New York City. Circular illustrating and describing the full line of GS tool chests for toolmakers and machinists. 26

Adjustable V-Belting

MANHEIM MFG. & BELTING Co., Manheim, Pa. Catalogue graphically illustrating the advantages of adjustable V-belts, and containing suggestions for installing these belts. 27

Lubricating Equipment

ALEMITE DIVISION OF STEWART-WARNER CORPORATION, 1826 Diversey Parkway, Chicago, Ill. Catalogue on Alemite progressive lubricating system for industry. 28

Materials-Handling Equipment

BARRETT-CRAVENS Co., 3250 W. 30th St., Chicago, Ill. Catalogue 414, containing 100 pages of information on materials-handling equipment. 29

Reduction Gears

WESTINGHOUSE ELECTRIC & MFG. Co., East Pittsburgh, Pa. Booklet B-2278, describing coupled reduction gears for lineshafts, compressors, generators, etc. 30

Metal Bellows

FULTON SYLPHON Co., Knoxville, Tenn. Bulletin 130, on metal bellows and bellows assemblies for a wide variety of applications in instruments and machinery manufacture. 31

Pneumatic Die Cushions

DAYTON ROGERS MFG. Co., 2830 S. Thirteenth Ave., Minneapolis, Minn. Bulletin illustrating and describing Model D universal pneumatic die cushions. 32

Thermit Welding

METAL & THERMIT CORPORATION, 120 Broadway, New York City. Booklet describing the Thermit welding process and its applications. 33

To Obtain Copies of New Trade Literature

listed on pages 224-226 (without charge or obligation), fill in below the publications wanted, using the identifying number at the end of each descriptive paragraph; detach and mail to:

MACHINERY, 148 Lafayette St., New York, N. Y.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

Name .... *Position or Title* ....

[This service is for those in charge of shop and engineering work in manufacturing plants.]

Firm ....

Business Address ....

City .... *State* ....

[SEE OTHER SIDE]

Milling Cutters

LOVEJOY TOOL CO., INC., Springfield, Vt. Catalogue 26, on Lovejoy milling cutters for modern metal-cutting requirements. 34

Rubber Transmission Belts

B. F. GOODRICH CO., Akron, Ohio. Catalogue Section 2150, on the selection and maintenance of rubber transmission belts. 35

Self-Lubricating Bearings

KEYSTONE CARBON CO., St. Marys, Pa. Catalogue containing list of sizes and code numbers of "Selflube" porous bearings. 36

Used Machine Tools

MOORE MACHINERY CO., 3876 Santa Fe Ave., Los Angeles, Calif. Bulletin listing a large selection of used machine tools. 37

Abrasives

CLOVER MFG. CO., Norwalk, Conn. Catalogue and price list of coated abrasives and grinding and lapping compounds. 38

Spray-Finishing Equipment

DEVILBISS CO., Toledo, Ohio. Catalogue IE, covering complete spray-finishing equipment for industrial use. 39

Roll Feeds for Presses

WITTEK MFG. CO., 4305 W. 24th Place, Chicago, Ill. Bulletin WF-339, on roll feeds for punch presses. 40

Electric Motors

GENERAL ELECTRIC CO., Schenectady, N. Y. Publication 3580, on Tri-Clad induction motors. 41

Steel and Tubes

A. B. MURRAY CO., INC., 145-165 Wolcott St., Brooklyn, N. Y. Stock List No. 3 on steel and tubes. 42

* * *

Winners in the Revere Defense Suggestion Contest

Nine typical workers in American industries have been awarded prizes in the contest inaugurated by Revere Copper and Brass Incorporated, New York City, for the best contributions made by workers in industry to America's defense plans.

The winner of the first prize of $5000, is Eugene Phillips, Fort Worth, Tex., creator of a system for the blind landing of airplanes. The second award, of $2500, went to William R. Holcomb, of Burbank, Calif., for an electromagnetic riveting gun. The third prize, of $1000, was awarded to Oscar B. Leibst, of Seattle, Wash., for a structural design eliminating the use of rivets and clips. In addition, cash awards of $250 each went to D. L. Wright, McComb, Ohio; Joseph A. Chyba, Baltimore, Md.; Martin J. Madison, Baltimore, Md.; Marcus A. Campbell, Saginaw, Mich.; John J. Kuettel, St. Paul, Minn.; and Clayte B. Barbee, North Hollywood, Calif.

Revision of S A E Steel Compositions

Comprehensive revisions of S A E steel specifications have just been published. The revised standards provide for 72 carbon and alloy steel grades, and 12 corrosion- and heat-resisting alloys, a total of 84 in place of the 109 S A E standard specifications included in the series which the new specifications replace. The revised series appears in the 1941 S A E Handbook recently published. It is the result of nearly a year's work by the Iron and Steel Division of the S A E Standards Committee. The last previous general revision of these specifications was made in 1935. For detailed information, address the Society of Automotive Engineers, 29 W. 39th St., New York City.

* * *

Special Course in Patent Law Offered

The Practising Law Institute is planning to conduct a special course on patent law, consisting of twenty 2-hour lectures to be given July 14 to 18. This course is designed primarily for patent lawyers, and hence the lectures are not elementary. The course will be given in air-conditioned quarters at the Hotel Astor, New York City. For further information, address the Practising Law Institute, 150 Broadway, New York City.

To Obtain Additional Information on Shop Equipment

Which of the new or improved equipment described on pages 227-244 is likely to prove advantageous in your shop? To obtain additional information or catalogues about such equipment, fill in below the identifying number found at the end of each description on pages 227-244—or write directly to the manufacturer, mentioning machine as described in July MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

Fill in your name and address on other side of this blank.

To Obtain Additional Information on Materials of Industry

To obtain additional information about any of the materials described on pages 222-223, fill in below the identifying number found at end of each description on pages 222-223—or write directly to the manufacturer, mentioning name of material as described in July MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.

Fill in your name and address on other side of this blank.

Detach and mail to MACHINERY, 148 Lafayette St., New York, N. Y.

[SEE OTHER SIDE]

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

W. F. & John Barnes Rifle Drilling Machines

Two rifle-barrel drilling machines with capacities for drilling bores up to 0.50 caliber are being built by the W. F. & John Barnes Co., Rockford, Ill. The machine shown in Fig. 1 (the 410), although designed primarily for rifle-barrel drilling, is also adapted for deep-hole drilling of parts such as camshafts, crankshafts, printing press rolls, boring-bars, propeller shafts, axles, hydraulic cylinders, etc.

A self-contained hydraulic unit imparts a positive feed to the barrels. The drills are fed entirely through the work, instead of being allowed to "break" through. This controlled hydraulic feed is designed to prevent excessive tool marks.

The two-spindle, hydraulically actuated headstock is mounted on 10-inch ways. Each spindle, mounted in anti-friction bearings, is driven directly through V-belts by a motor mounted on top of the unit. Spindle speeds are changed by replacing the sheaves and belts. The spindles are furnished with cup centers to receive parts directly, or they can be equipped with chucks. The tailstock is coupled to the headstock by two ground tie-bars to form an integral unit. Each spindle has a retractable quill, and is individually actuated by a rack and pinion provided with a cam lock. Standard quills are equipped with ball-bearing centers to receive locating and tool guiding bushings. Non-symmetrical parts are readily accommodated through the use of revolving, cradle type fixtures.

The tool shank is received by individual holders mounted on a common saddle. Each holder can be moved on individual ways to suit variations in tool length. The saddle carrying the two holders can be locked to the ways at different positions to accommodate work of various lengths. The tool-holder has a torque overload protector which automatically returns the headstock to the starting position when the torque passes a safe value. A pilot light on the push-button panel indicates which tool is overloaded.

The center-to-center distance between the two spindles is 7.500 inches, and the distance from the centers of the spindles to the ways is 8.375 inches. The spindle nose is flanged and tapped to receive chucks. The 3-H.P., 1800 R.P.M. motor provides spindle speeds of from 1000 to 2000 R.P.M. The feed rate ranges from 1/4 inch to 9 inches per minute. The forward traverse is at the rate of 190 inches per minute, and the return traverse at 160 inches per minute. The tailstock quill is 3.375 inches in diameter, and has a movement of 1 5/8 inches. The machine is made in three stroke lengths of 24, 36 and 48 inches.

The six-spindle vertical rifle drilling machine shown in Fig. 2 is designed as a unit for the rapid drilling of rifle barrels within a minimum floor space. The machine is controlled with push-buttons from a platform, so arranged that two machines can be placed opposite each other to permit one operator to control the drilling of twelve barrels simultaneously with minimum effort.

Each of the six spindle heads is actuated by an individual hydraulic unit. Each has an automatically actuated three-jaw self-centering chuck for holding the barrel, and is driven by a cartridge type motor through V-belts. The revolving barrels are fed downward over stationary single-lip drills, each spindle being provided with coolant from a separate pump. The spindle heads are guided by opposed V-type ways.

The headstock is coupled to the tailstock by ground steel tie-bars to provide accurate alignment and to cause these members to move as an integral unit. The tool-holder is

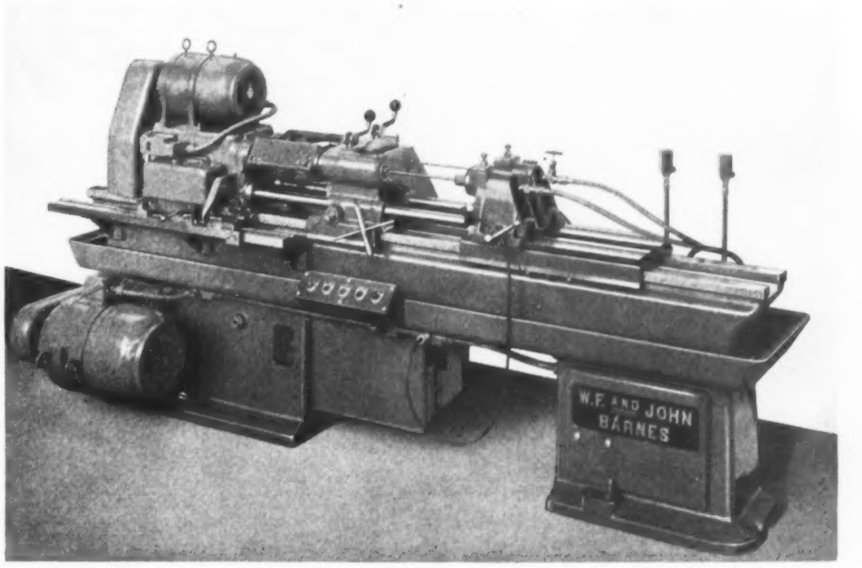


Fig. 1. Two-spindle Rifle Drilling Machine Manufactured by W. F. & John Barnes Co.

To obtain additional information on equipment described on this page, see lower part of page 226.

mounted on a slide designed to accommodate drills of different lengths. This holder can be manually swung out of position so that the drills can be either withdrawn or placed in the holder. Each tool-holder has an electrically interlocked torque overload protector coupled with the hydraulic system. A pilot light indicates which tool is overloaded.

The chips and coolant are removed from the machine by a motor-driven screw type chip conveyor. The filtering system removes small chips from the coolant, which is circulated by six high-pressure pumps driven by the motor which also drives the six individual hydraulic feed units.

This machine will drill 0.30 and 0.50 caliber barrels up to 45 1/2 inches in length, with a maximum outside diameter of 1 3/4 inches. Spindle speeds range from 1000 to 2030 R.P.M. The 2-H.P. spindle motors, of the cartridge type, have a speed of 1800 R.P.M. The chip conveyor is driven by a 3/4-H.P. gear motor. The feeds range from 1/4 inch to 9 inches per minute; the forward traverse is at the rate of 190 inches per minute, and the return traverse at 160 inches per minute. The machine has a height of 12 feet 6 inches, a width of 10 feet 5 inches, and a depth of 6 feet. The weight is 30,000 pounds. 51

Despatch Improved Heat-Treating Furnace

An improved line of CF heat-treating furnaces has recently been brought out by the Despatch Oven Co., Minneapolis, Minn. These furnaces are particularly suitable for tool-room tempering and drawing work, for the heat-treatment of aluminum rivets, and aluminum-alloy and magnesium-alloy castings and parts, for the preheating of aluminum billets before forging, and for general production work requiring a temperature range of from 300 to 1200 degrees F.

The body construction of the new design has been made considerably heavier, and heavy-duty lift doors are used in place of the former swing type. Special compression type latches provide easy operation and insure a tight seal. A high-capacity alloy fan furnishes large volumes of circulating air.

This type of furnace is available with either gas or electric heat. In the gas-heated furnace, controlled combustion is obtained by an adjustable back-pressure baffle that maintains correct combustion-chamber temperature. No blowers or factory air supply is required. In the electrically heated furnace, long-life open-coil heating elements are used, and these are so mounted that they can be quickly replaced without cooling the load or furnace interior.

A temperature uniformity of plus or minus 5 degrees F. is maintained during operation. Four standard sizes are available, ranging from 13 by 13 by 13 to 37 by 25 by 37 inches, in both gas heated and electrically heated types. Furnaces with a temperature range of either 300 to 850 or 300 to 1200 degrees F. can be obtained in each of the four sizes. 52

Westinghouse Control for Welding Aluminum

For welding aluminum and alloys such as are used in the aircraft industry, a new capacitor discharge resistance welding control has been developed by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Known as the "Condens-O-Weld," this unit is a complete control designed to include in one floor-mounted cabinet all the necessary apparatus required to control an electrostatic energy-storage type of welder. It is intended for operation on 230/460 volts ($\pm$ 10 per cent), three-phase, 50- or 60-cycle current. Speeds of forty to eighty spot welds per minute are obtainable. 53

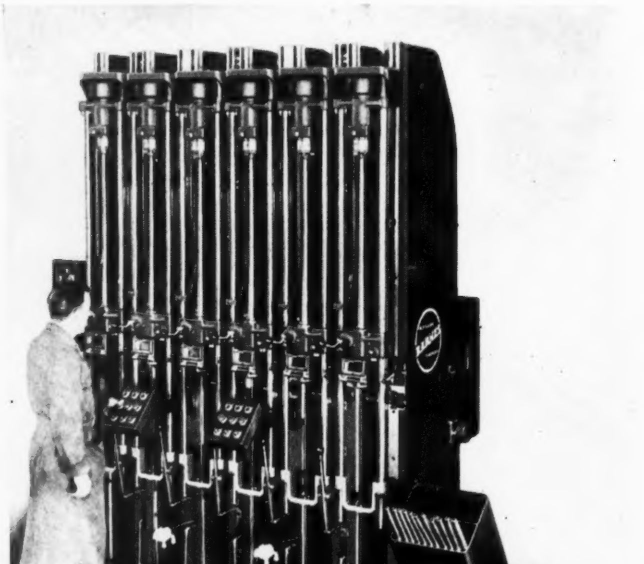
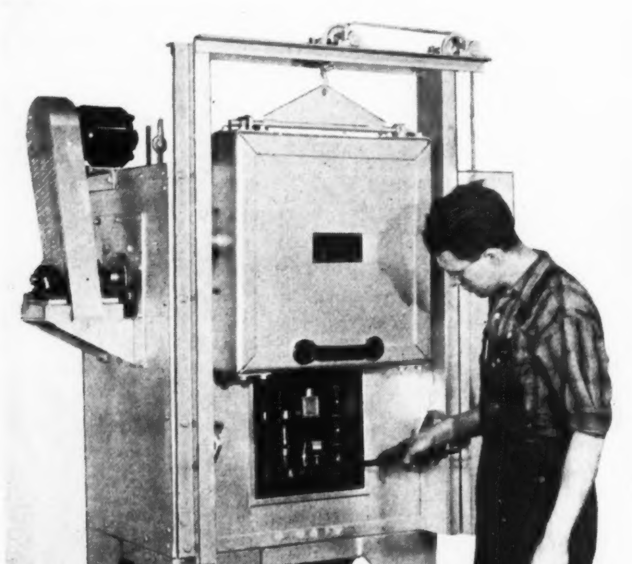


Fig. 2. W. F. & John Barnes Six-spindle Rifle-barrel Drilling Machine



Despatch Improved Heat-treating Furnace of the All-around Utility Type

To obtain additional information on equipment described on this page, see lower part of page 226.

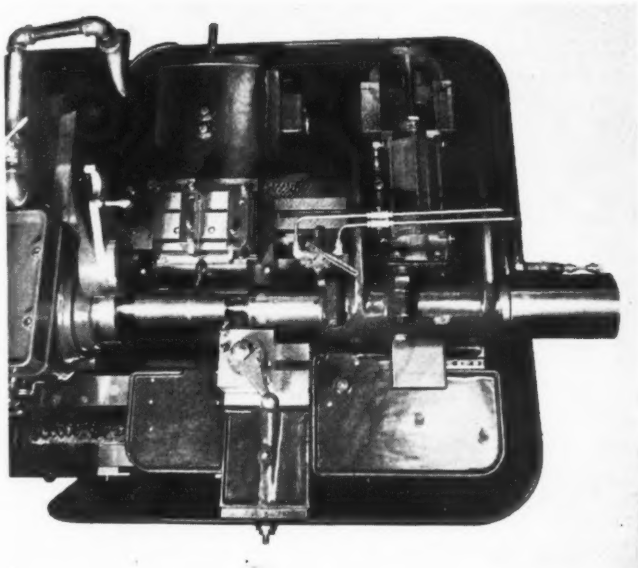


Fig. 1. Sundstrand Automatic Lathe Equipped for Machining 3-inch Shells

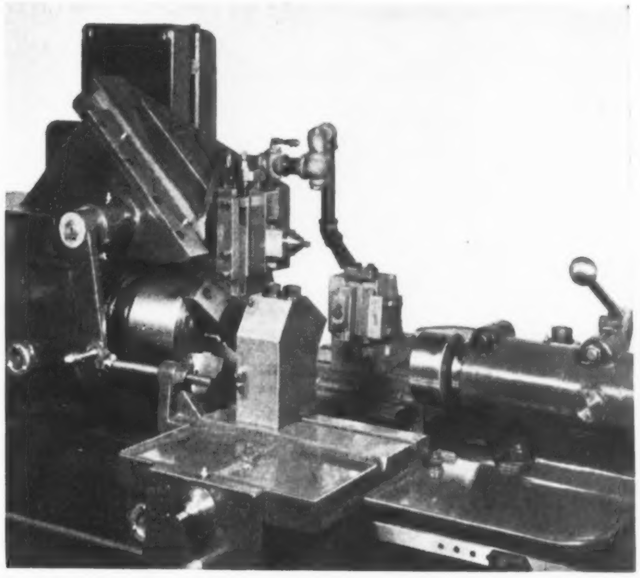


Fig. 2. Automatic Lathe Equipped for Machining Copper Rotating Band on Shells

Sundstrand Automatic Lathes Equipped for Shell Turning

The Model 10 automatic lathe built by the Sundstrand Machine Tool Co., 2530 Eleventh St., Rockford, Ill., has been equipped for rough- and finish-turning the outside and facing both ends of 3-inch anti-aircraft shells. The same machine has also been equipped for turning the copper rotating band on four sizes of shells.

The tool equipment for machining the 3-inch shells is shown in Fig. 1. The rough shell, made from tubing, is held on an expanding type mandrel attached to the machine spindle. The outer end of the mandrel has a pilot supported by the tailstock.

The front carriage has a cam-bar actuated tool-slide on which is mounted a turret type tool-block. This block carries rough- and finish-turning tools. Between cuts, the operator indexes the tool-block, so that both cuts are taken with one chucking of the work. The complete outside of the shell, including the ogive, is turned in this operation. Turning of the ogive is accomplished by using a special contour-turning cam bar which controls the crosswise movement of the tool-slide.

The machine has an automatic cycle of rapid approach, feed, rapid return, and stop, all timed and interlocked with the starting and stopping of the machine cycle. Tungsten-carbide tipped tools are used at a turning speed of 280 surface feet per minute with a feed of 0.020 inch. The floor-to-floor time, taking rough and finish cuts, is 2.85 minutes.

The equipment for turning the copper rotating band on one of four different sizes of shells is shown in Fig. 2. The four shells machined are the 105- and 155-millimeter shells, the 5-inch common projectile, and the 5-inch navy shell. All these shells have different types of bands which require special features in the tool equipment. The tooling, however, is made as universal as possible, so that little time is required for changing over the machine.

A three-jaw air-operated chuck has a set of form-fitting jaws for each size of shell. These jaws grip the shell on the outside taper of the boat-tail section and have a shoulder that locates the shell endwise. The nose end is supported in a cup type center which is moved into and out of position by an air cylinder.

On the standard longitudinal-feeding front tool-slide is mounted a double-deck tool-block with two tungsten-carbide tipped turning tools. One of the tools is set approximately 1/8 inch ahead of the other so that a roughing and a finishing cut are taken over the band surface with one cycle of the front tool carriage. On the cross-feeding rear tool-slide is mounted a vertical type tungsten-carbide tipped form tool which finish-forms and grooves the band. Attached to the form tool is a high-speed steel "corner-break" tool which breaks all sharp corners on the grooves.

The 5-inch navy shell has an angular under-cut in the band. To machine this under-cut, an angular-feeding overhead slide is mounted on the headstock. This third slide is fed at an angle of 45 degrees by the longitudinal movement of the front carriage. The automatic cycle is similar to that previously described.

A turning speed of 400 surface feet per minute and a feed of 0.016 inch per revolution are employed in machining all four shells. The production obtained when operating at 85 per cent efficiency is 75 pieces per hour for the 105-millimeter shell, 28 pieces per hour for the 155-millimeter shell, and 37 pieces per hour for the 5-inch common projectile and the 5-inch navy shell. 54

General Electric Atomic-Hydrogen Arc Welders

Atomic-hydrogen arc welders of improved design have recently been brought out by the General Electric Co., Schenectady, N. Y. These welders, of 35- and 75-ampere capacity, are finding increasing use in industry for repairing tools and dies, for filling flaws or blow-holes in steel and bronze castings, and for the fabrication and repair of metals difficult to weld.

Instead of the transformer and reactor used in previous units, the new welder has a specially designed reactive transformer which combines the functions of both the transformer and reactor. As a result, the weight of the welder has been reduced more than 30 per cent and electrical characteristics improved. A built-in power factor correction feature helps to reduce installation and operating costs. 55

To obtain additional information on equipment described on this page, see lower part of page 226.

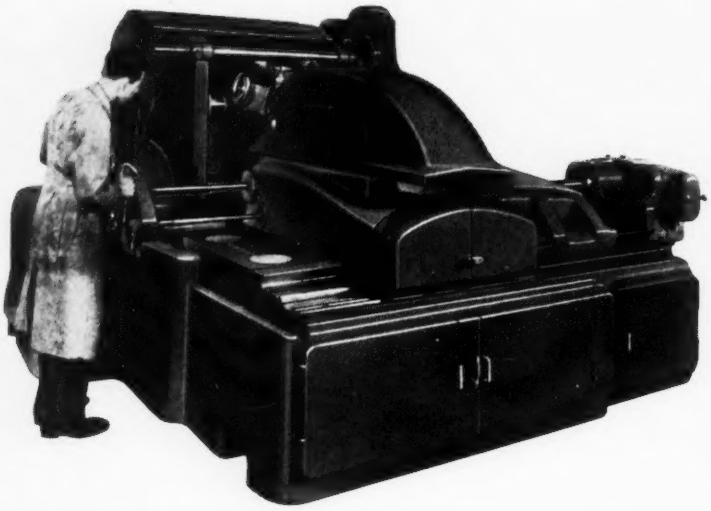


Fig. 1. "Red Ring" Gear-shaving Machine with Capacity for Handling Gears up to 36 Inches in Diameter

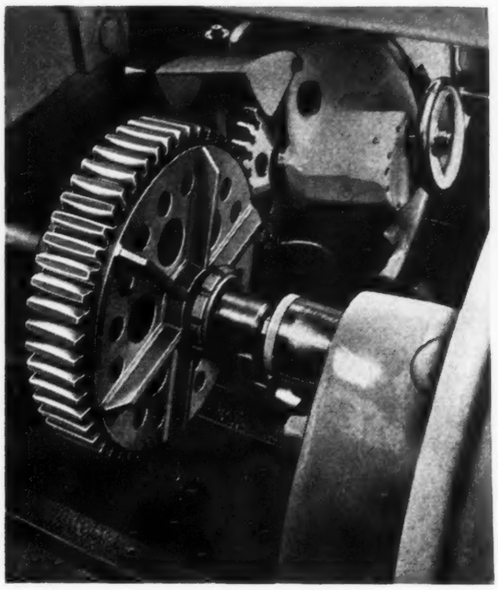


Fig. 2. Close-up View of Work and Cutter in Machine Shown in Fig. 1

"Red Ring" Gear-Shaving Machine

A horizontal "Red Ring" gear-shaving machine weighing 36,000 pounds, designed for shaving the teeth of gears up to 36 inches in diameter, of 2-inch pitch, having face widths up to 36 inches, has just been brought out by the National Broach & Machine Co., 5600 St. Jean St., Detroit, Mich. Contrary to general practice in shaving smaller gears, the cutting tool of this large machine is driven by the work-gear. This eliminates the high driving torque which would result if the cutter, as in smaller machines, drove the work-gear, especially when the work-gear was very heavy.

As in other "Red Ring" gear-shaving machines, the cutter-head is built for crossed axes settings, and is provided with a sine bar adjustment for making duplicate settings. After making the proper setting, the cutter-head is locked in position. The reciprocating speed of the cutter, and the speed of the work-gear spindle can be varied by changing pick-off gears in the work-head drive.

An important feature is the provision for developing the elliptoid tooth form designed to eliminate gear failures and rapid gear wear caused by excessive bearing pressures at the ends of the gear teeth. The use of the elliptoid tooth form has also been of material assistance in reducing gear noise.

The cutter-head slide is adjustable for various center distances up to 50 inches. The cutter-head accommodates cutting tools 7, 9, and 12 inches in diameter.

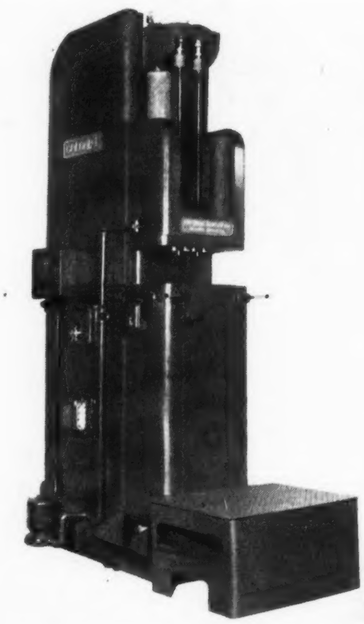
This new shaving machine is entirely automatic, its action being under the control of Microflex timing units which, in turn, are controlled by elements on the electrical panel board in the base of the machine. When desired, as, for instance, in setting up the machine, the automatic feed can readily be disengaged and the machine operated manually. A coolant pump, with reservoir in the base, provides an ample supply of coolant. A push-button control motor, with limit switches, opens and closes the splash plate. 56

Colonial Pull-Up Broaching Machines

A line of improved pull-up broaching machines has been developed by the Colonial Broach Co., 147 Jos. Campau Ave., Detroit, Mich., primarily to obtain maximum production in machining round and splined holes. The peak capacities of the entire line of machines have been substantially increased to provide greater reserve power and smoother operation when tooling is adapted for the normal machine capacities.

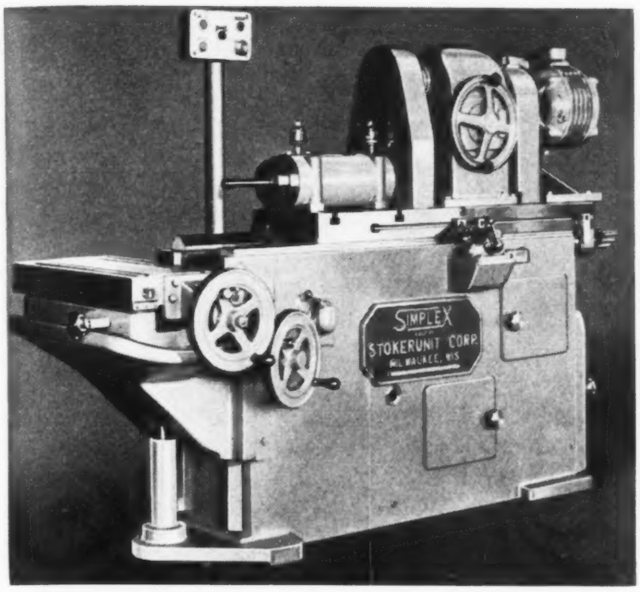
The machine platen and puller brackets provide ample space for pulling two or more broaches at one time. Provision is made for mounting spiral broach drive-heads when mechanical means of rotating the broach is required to machine spiral splines. Automatic handling of the broach is effected by the use of a hydraulic mechanism. Dual hand controls make it impossible to start the broach until both hands are on the operating levers.

This new line comprises the following regular models: 6- and 10-ton capacity machines (normal rating) both with either 36- or 48-inch stroke; and 15- and 25-ton capacity machines, both with either 48- or 60-inch stroke. Presses with special tonnage and stroke capacities can also be supplied. 57



Colonial Broaching Machine of Improved Design

To obtain additional information on equipment described on this page, see lower part of page 226.



Simplex Knee Type Precision Boring Machine with Variable-speed Spindle Drive and Table Stop

Lathe with Roller-bearing Headstock Built by the Sheldon Machine Co.

Simplex Unit Type Precision Boring Machines

A line of precision boring machines known as the "Simplex" has recently been placed on the market by the Stokerunit Corporation, 4547 W. Mitchell St., Milwaukee, Wis. These machines are built up from spindle, table, hydraulic feed, and electrical control units of various sizes that can be applied singly or in multiple to bed units designed to meet production needs.

The use of welded-steel beds facilitates size and structural modifications to suit the job. A variable-delivery pump for the hydraulic feed system and a constant-delivery pump for rapid traverse and accessory operation provide for all available combinations of rapid traverse, feed in both directions, feed acceleration between cuts, and facing feeds desired, as well as variable dwell periods and facing to a positive stop.

The spindles are driven by V-belts; sheaves are readily interchanged to obtain different speeds. A variable-speed drive system can also be supplied. Limit switches are provided, and electrically operated hydraulic valves permit hair-line control of feeds when facing to shoulders or accurate depths.

The range of spindle speeds covered by the four sizes of heads is from 200 to 6000 R.P.M. Holes from 1/4 inch in diameter up, depending on the length, can ordinarily be bored to an accuracy of 0.0002 inch, and to 0.0001 inch under ideal conditions. The machines can also be adapted for drilling, milling, and turning operations.

The knee type machine illustrated will handle a wide variety of precision work. The table, mounted on the knee, can be hydraulically indexed between two adjustable stops or moved by a screw actuated by a handwheel. This knee type machine is available in two sizes. The table of the smaller size is 13 by 27 inches, has a horizontal travel of 10 inches, and a vertical travel of 10 inches. With a No. 3 spindle, the maximum distance from the center line of the spindle to the top of the table is 16 1/4 inches, and the minimum distance 6 1/4 inches. The spindle has a travel of 12 inches, a speed range of 300 to 2700 R.P.M., a feed range of from 0 to 20 inches per minute, and a rapid traverse of 200 inches per minute. 58

Sheldon Lathes

The Sheldon Machine Co., Inc., 1627 N. Kilbourn Ave., Chicago, Ill., has recently brought out 11- and 12-inch lathes with preloaded ball- or precision roller-bearing headstocks. These lathes have a 1-inch collet capacity and a spindle hole 1 3/8 inches in diameter. They are available in both bench and floor types, with quick-change gear-boxes, plain aprons or worm-feed aprons, and power cross-feed.

The choice of motor drives available includes the Sheldon needle-bearing overhead motor drive and the Sheldon four-speed lever-operated underneath motor drive, entirely enclosed in a cabinet leg. A complete line of attachments and accessories is available for each of the new lathes. 59

Hunter Vertical Slotter

A variable-speed vertical slotter designed for die shop, tool-room, and general repair shop operation has recently been introduced on the market by the Hunter Engineering Co., Riverside, Calif. A number of features are incorporated in this machine which make it adaptable to a

Variable-speed Vertical Slotter Made by Hunter Engineering Co.

To obtain additional information on equipment described on this page, see lower part of page 226.

wide variety of machining operations.

The work-table is provided with longitudinal T-slots, and is adjustable by hand in longitudinal and transverse directions, as well as vertically. The ram has a maximum stroke of 4 1/2 inches and can be tilted to either right or left through a 10-degree angle for such operations as the cutting of tapered keyways. The number of strokes per minute can be varied from 90 to 180. A positive-acting clutch, controlled from either side of the machine, makes it possible to stop the ram at any point. The machine measures 63 3/8 by 38 by 48 inches. 60

Reed-Prentice Multiple Stops for Engine Lathes

The Reed-Prentice Corporation, 677 Cambridge St., Worcester, Mass., has recently brought out automatic multiple-length stops and adjustable multiple cross-stops for the engine lathes of its manufacture. The automatic multiple-length stops applied to an engine lathe, as shown in Fig. 1, are designed for use in accurate duplicating of shoulder lengths. As shown, a sliding bar at the front of the lathe is coupled to the clutch shifter rod and carries a number of adjustable stop-dogs. A stop-handle on the apron engages the dogs in turn, moving the bar and disengaging the feed. A touch on the stop-handle releases the dog, causing the rod to slide back into position and the feed to be automatically engaged, the stop-handle riding forward ready to engage the succeeding stop-dog for the next shoulder length.

The adjustable multiple cross-stops, shown through the phantom view of the chip guard in Fig. 2 are built for use in the accurate duplication of diameters. This stop unit consists of a rod mounted in brackets across the carriage wings, and a block with six adjustable stops. The stop-block slides on the cross-rod, on which it is securely clamped. The stops are adjustable for the series of diameters required, and can be rotated by the knurled knob at the front into position for making contact with the hardened stop-dog attached to the compound-rest cross-slide. After rotation, the dog is held in position by a spring plunger. 61

Lincoln Arc Welder Designed for Use in Aircraft Manufacture

Lincoln Arc Welder for Aircraft Work

An arc-welding machine designed particularly for airplane welding has been developed by the Lincoln Electric Co., 12818 Coit Road, Cleveland, Ohio. The most important of the features that adapt this welder specifically for aircraft work is the system of welding current and voltage control, which provides for the accurate settings essential for welding the materials employed in modern plane construction. The control system allows independent adjustment of both welding current and voltage.

The unit delivers 10 amperes at the arc without extra attachments, and is suited for welding the lighter gages of aircraft steels, as well as heavy materials. The welder is of the motor-generator, single-operator, variable-voltage type. Connections are readily accessible for either 220 or 440 volts. The welder is also supplied for 550 volts or special voltages of either two or three phase. It occupies less than 4 square feet of floor space, and is of arc-welded steel, drip-

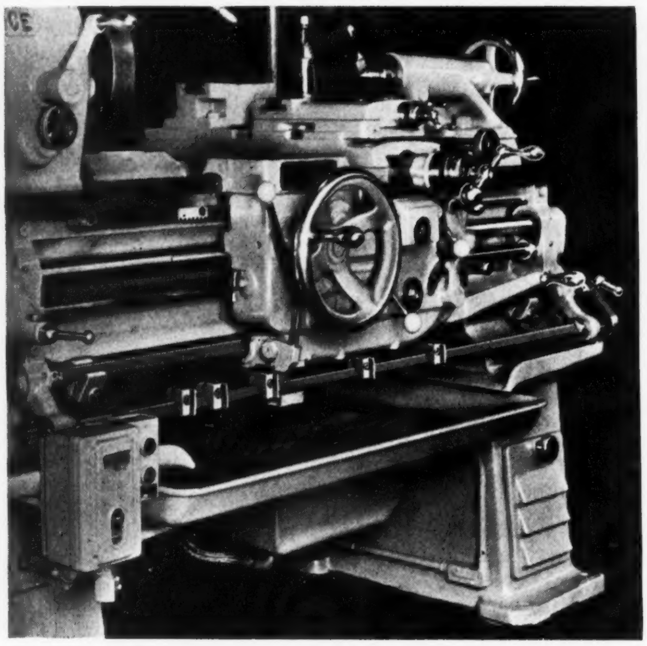


Fig. 1. Reed-Prentice Lathe Equipped with Automatic Length Stops

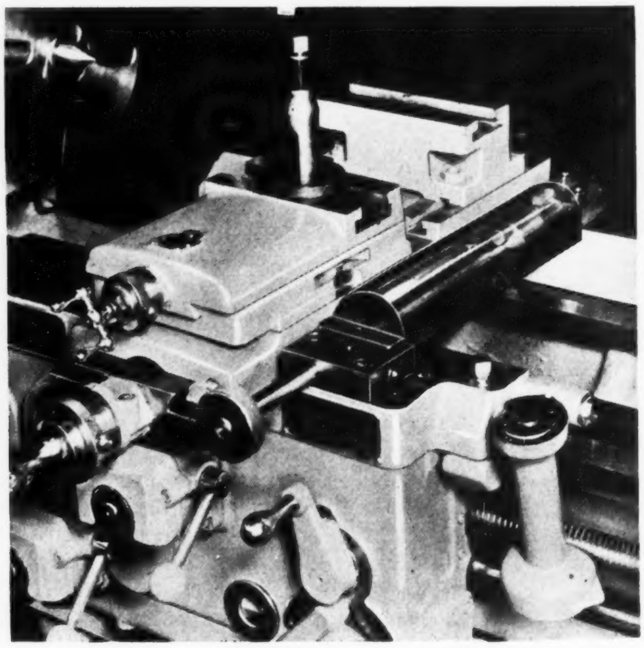


Fig. 2. Adjustable Cross-stops Applied to Reed-Prentice Lathe

To obtain additional information on equipment described on this page, see lower part of page 226.

proof construction. Two models are available—a 150-ampere size and a 200-ampere size, both made in portable and stationary types. 62

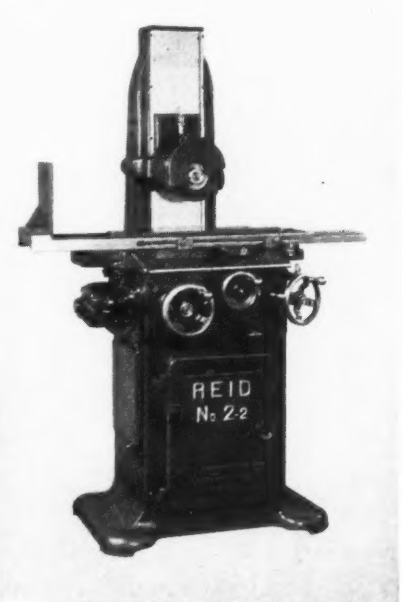
Reid All-Electric Surface Grinder

Reid Brothers Co., Inc., Beverly, Mass., has developed a 6- by 18-inch, all-electric, tool-room surface grinder for which the H. Leach Machinery Co., 387 Charles St., Providence, R. I., is the selling agent. The longitudinal and cross feeds are operated by a 1/4-H.P. reversible motor. This feeding arrangement eliminates many mechanical parts and thus insures smoother operation.

A 110-, 220-, 440-, or 550-volt, 25- or 60-cycle, one-, two-, or three-phase motor can be employed to drive the grinder. The table speed is 20 feet per minute. The grinder table is operated by a silent chain in place of a rack-and-pinion gear. All shafts have ball, roller, or Oilite bearings. Both cross-slide and table are equipped with oil rollers to insure longer life. The entire machine is guarded against abrasive dust.

This grinder can be operated either as a hand- or a power-fed machine, and can be quickly changed over from one to the other. A separate switch on the front of the machine permits the operator to employ the spindle by itself, thereby eliminating the motor for the power feed, or by throwing the switch in the opposite direction, he can operate both the spindle and the feeds. The entire machine is equipped with safety switches, making it impossible to jam the machine. The cross-feed is equipped with an automatic knock-off when the machine is operated under the power feed.

The 2-B machine can be equipped with five different types of spindles: The Reid regular spindle, Pope S K F roller-bearing spindle, or the choice of three different motorized spindles. When belt-driven spindles are used, a 1-H.P. motor is required in the base of the machine. 63



All-electric Surface Grinder Developed by Reid Bros. Co.

Linde Portable Acetylene Generator

A portable acetylene generator for use in oxy-acetylene welding and cutting operations has just been placed on the market by The Linde Air Products Co., unit of Union Carbide and Carbon Corporation, 30 E. 42nd St., New York City. This generator, known as the "Oxweld MP-10," will deliver 30 cubic feet of acetylene per hour, and is suitable for use in welding metal up to 3/8 inch thick and for cutting steel up to 5 inches thick. It is designed for maximum portability, from the standpoint of weight and height, and can readily be moved about the shop or to any outside job. The carbide hopper holds 15 pounds of 14 ND Union carbide and can be quickly recharged. 64

Linde Portable Acetylene Generator

Cleveland Four-Point Press

A four-point press measuring 108 inches between the uprights and having the capacity for exerting a pressure of 500 tons has been brought out by the Cleveland Punch & Shear Works Co., Cleveland, Ohio. This press is identical front and back, and has been designed to eliminate overhanging brackets or other projecting members in order to reduce the required space to a minimum. The gears, located in the box type crown with the drive unit, run in oil. An overflow limit in all gear housings permits the excess oil to return to the reservoir in the slide. All bearings are lubricated by an automatic power-operated pump using pressure feed lines and return lines to the oil sump.

The press is equipped with an electrically controlled, hydraulically operated friction clutch and brake, the flywheel being provided with a separate air brake which is used to bring it to a quick stop when the power is shut off. The slide is counterbalanced by air cylinders enclosed in the uprights. Openings in the uprights accommodate an automatic feed.

This press operates at the rate of 14 strokes per minute, and has a 24-inch stroke and a 6-inch adjustment for the slide. The press can also be furnished in single- and two-point designs having one and two connections, respectively, and in

Four-point Press Brought out by Cleveland Punch & Shear Works

To obtain additional information on equipment described on this page, see lower part of page 226.

sizes and capacities to meet requirements. Any of the three types can be equipped with either a pneumatic or a hydraulic friction clutch. 65

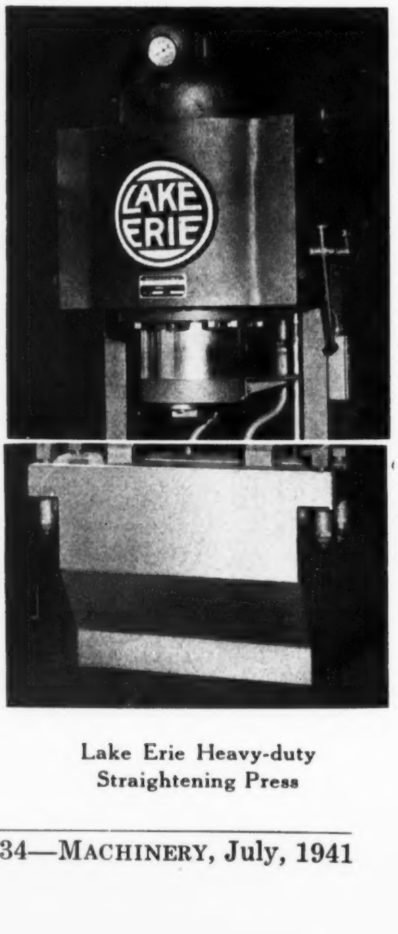
T-Square with Transparent Blade

A T-square with a transparent blade made of the plastic Escolite has been placed on the market by the Engineering Sales Co., Sheboygan, Wis. The blade is 0.09 inch thick, and the head (of black laminated Bakelite composition) is 5/16 inch thick. It is claimed that neither the blade nor the head will warp, bow, chip, crack, or split, and that the transparent blade will not discolor or become brittle. A special die-casting and a single screw hold head and blade together, permitting instant separation for using the blade as a straightedge or replacing the fixed head with a swivel head. 66

Heavy-Duty Straightening Presses

A line of heavy-duty hydraulic straightening presses of the C-frame type is being placed on the market by the Lake Erie Engineering Corporation, 1170 Kenmore Station, Buffalo, N. Y. The presses of this new line are especially designed for convenient handling of long bars and for fast operation with sensitive control of the pressure and stroke.

The press beds are fitted with V-blocks that are adjustable to suit the work. Spring rollers at the ends facilitate movement of the bars. The desired pressure can be applied to the work by operating a conveniently located hand-lever. The hydraulic pumping unit is located at the bottom and to the rear of the press. 67



Lake Erie Heavy-duty Straightening Press

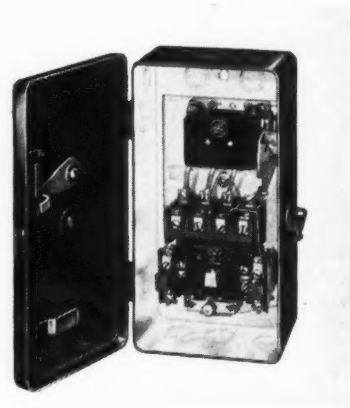
Diamond Hydraulic Press

A utility or general-purpose hydraulic press, which is designed to handle a variety of work but is also adapted for use on production lines, has just been brought out by the Diamond Machine Co. of Philadelphia, 2447 Aramingo Ave., Philadelphia, Pa. This press—the "Diamond 40"—can be used for assembling, broaching, straightening, riveting, forcing, and pressing.

In operation, the hand-lever is simply pulled forward or the foot-pedal depressed to start the working stroke, and released for the return stroke. The speed of the automatic return stroke is double that of the approach stroke. The steel ram is guided for the full length of its travel by a cross-head which rides on four rigid tension rods. The travel of the cross-head is limited by follow-up stops, and the return stroke by an adjustable follow-up stop.

Power is furnished by a high-pressure Hele-Shaw pump. The oil tank, electric motor, hydraulic pump, and the controls for these units are compactly grouped at the top of the press and covered by a removable housing. Relief valves in the oil circuit protect the press from overloading. An overload relay also protects the electric motor. Two gages for the oil system are provided. One indicates the total pressure of the piston and the hydraulic pressure in the system, and the other shows the oil level.

The base of the press is 12 inches high, and has a 10-inch hole centered under the ram. A 16-inch V-table is furnished with the press, but 6- and 10-inch V-tables and a 12-inch extension table are available. The total daylight capacity is 4 feet 6 inches without the V-table, and 3 feet 2 inches with the standard V-table. The diameter of the ram is 4 inches, the stroke 24 inches, and the maximum pressing capacity 40 tons. The overall height is 9 feet 7 3/4 inches, and the floor space required, 2 feet 8 inches by 3 feet 8 inches. 68

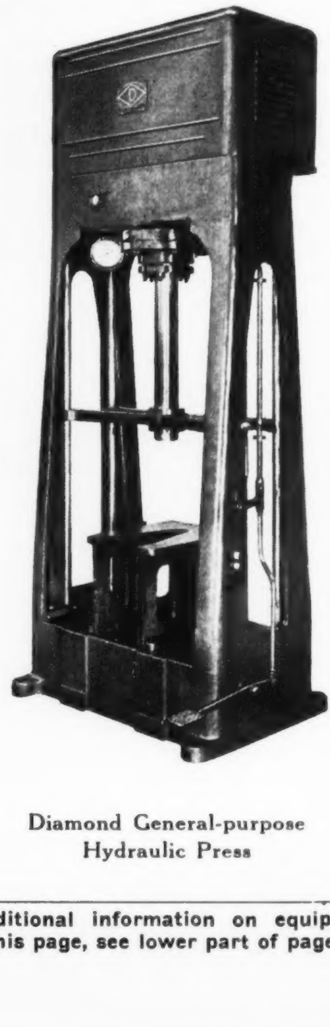


Combination Starter Brought out in Four Sizes

Allen-Bradley Combination Starters

A unique handle-locking arrangement and a compact, high-capacity disconnect switch are among the new features of an improved line of Bulletin 712 combination starters brought out by the Allen-Bradley Co., 1331 S. First St., Milwaukee, Wis. By combining a magnetic switch with a hand disconnect switch in the same enclosure, these starters save wiring and insure greater safety to the operator.

Bulletin 712 combination starters are available in four sizes with a



Diamond General-purpose Hydraulic Press

To obtain additional information on equipment described on this page, see lower part of page 226.

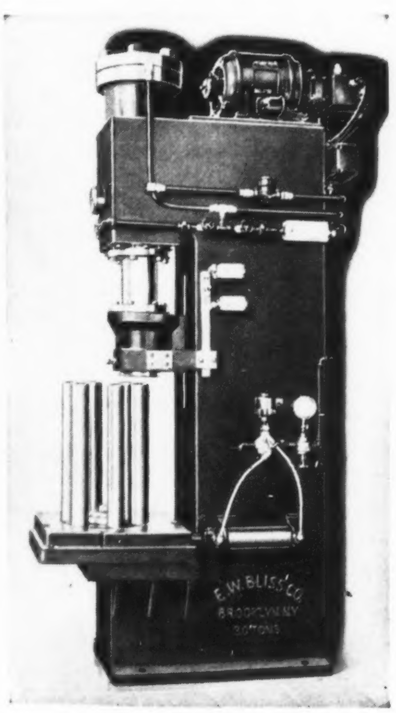
variety of enclosures, and can be obtained with or without fuse clips. Ratings range from 2 H.P., 220-440-550 volts for the size 0 starter to 30 H.P., 220 volts, and 50 H.P., 440-550 volts for the size 3 starters. All sizes have an interrupting capacity of at least ten times the maximum horsepower rating. Locked rotor currents are disrupted by either the solenoid switch or the disconnect switch. 69

Bliss Hydraulic Marking Press

The E. W. Bliss Co., 53rd St. and Second Ave., Brooklyn, N. Y., has recently developed a high-speed hydraulic marking press equipped with a dial feed. Many safety features and automatic devices have been incorporated in this new marking press. It has a capacity of 30 tons and a stroke of 12 inches. The six-station dial feed is pneumatically operated in sequence with the press stroke, so that continuous operation is obtainable. Production up to 20 pieces per minute can be obtained with this press, loading being accomplished during the pressing cycle.

The drive is through a 5-H.P. motor. The sequence of operations is electrically controlled, with interlocks so that the press ram cannot descend until the dial is properly positioned, and the dial cannot be rotated until the press ram is in the raised position. Another safety feature is the no-work control by which the press slide is prevented from descending if no work is in place.

The dial is positively locked in position during the descent of the press ram. Although the press has a capacity of 30 tons, the pressure can be adjusted to as low as 3 tons, and the stroke can be adjusted to as low as 1 inch, if necessary. 70



Bliss High-speed Hydraulic Marking Press

Root Hydraulic Multiple Drilling Machine

The B. M. Root Co., York, Pa., has brought out a Style F408 hydraulic multiple drilling machine equipped with an indexing table for use in performing operations such as chamfering, reaming, counterboring, and facing, as well as drilling. This machine will perform a combination of these operations as required to complete one part in the time consumed by the longest single operation.

The indexing table carries four fixtures, as shown, providing one loading station and three work stations. Pressing a single-cycle button automatically withdraws the table-locking pin, indexes the table 90 degrees, reinserts the locking pin, and sets the work-head in motion. The head moves through rapid traverse, feed, and rapid return.

The multiple drilling, reaming and chamfering head illustrated comprises three groups of four spindles each, spaced at 90 degrees, and driven from a single-head motor. Each spindle is made to accommodate tapered shanks, and is provided with depth adjustment. The spring jig plate is attached to the head, and is equipped with hardened-steel guide bushings for the tools and a centering bushing for locating the jig.

The travel of the motorized head unit is controlled by limit switches which provide rapid traverse, feed, reverse, and stop. All motions are controlled by a push-button panel.

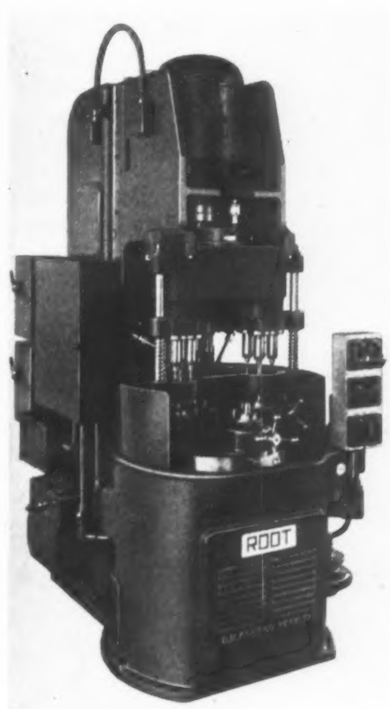
The work-table is 20 inches in diameter, and the head unit has a maximum movement of 7 inches. The feeding rate is from 0 to 25 inches per minute; the rapid advance rate, 180 inches per minute; and the rapid return, 250 inches per minute. Spindle speeds are furnished to suit requirements. A 5-H.P. motor is used to drive the spindle, and a 2-H.P. motor is employed for the hydraulic feed. The machine occupies a floor space of 44 by 54 inches, and weighs 7500 pounds. 71

Chip-breaker Grinder Made by Hammond Machinery Builders

Hammond Chip-Breaker Grinder

A machine for grinding chip-breaker grooves in carbide tools with a 4-inch peripheral diamond wheel, which is built around a new type of universal angle tool vise, has been placed on the market by Hammond Machinery Builders, Inc., 1619 Douglas Ave., Kalamazoo, Mich. The vise provides three separate planes of adjustment for setting the tool to the desired grinding angle. Adjustment in each plane is made by accurate scale readings.

After the tool is properly positioned, the table is reciprocated at right angles to the base of the machine to form the groove by means



Root Multiple Drilling Machine with Indexing Table

To obtain additional information on equipment described on this page, see lower part of page 226.

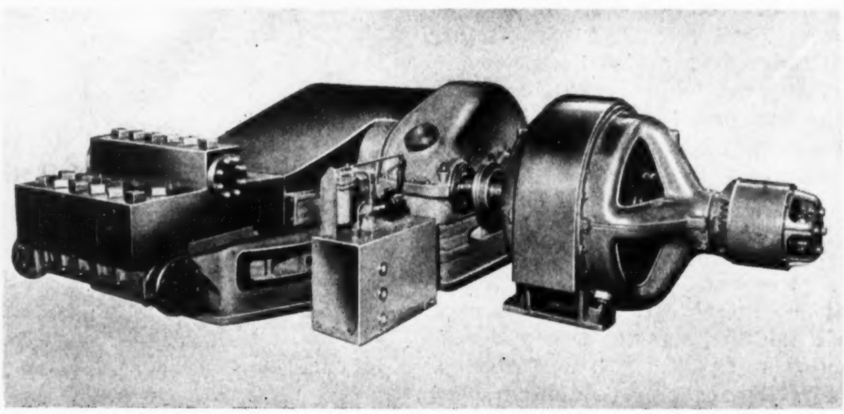
of the lever projecting from the front of the grinder. For wet grinding, a coolant tank is mounted over the 4-inch wheel. The flow of coolant is controlled by a needle valve.

The grinding assembly on the left side of the machine can be used for rough- or finish-grinding carbide tools with a 6-inch silicon-carbide or diamond cup-wheel mounted on the left-hand spindle. The chip-breaker grinder is driven by a ball-bearing, 1/2-H.P., heavy-duty, reversing type motor which permits right- or left-hand grinding. This motor runs at a speed of 3450 R.P.M. The grinder is available in either a bench or a floor model. 72

Baldwin-Southwark High-Pressure Pumps

A line of high-pressure pumps has recently been introduced by the Baldwin Southwark Division of the Baldwin Locomotive Works, Philadelphia, Pa. Although not previously announced, several units of this new line have been in operation for more than a year. The pumps are designed to handle comparatively large volumes of water in conjunction with hydraulic press installations. As the name implies, the "Triplez" pump employs three pistons — an arrangement designed to provide a 60-degree overlap in the discharge impulses, which tends to smooth out pulsations.

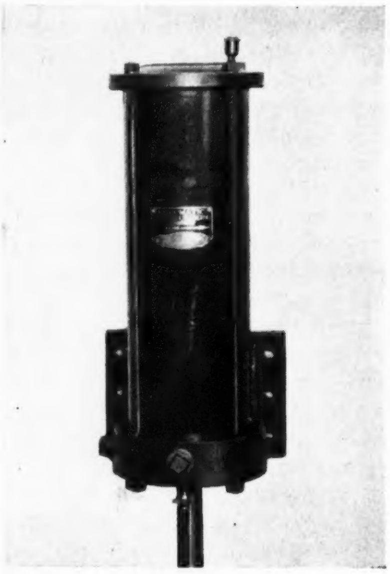
The 12-inch stroke pump discharge ranges from 23 gallons per minute at 7500 pounds pressure per square inch to 160 gallons per minute at 1000 pounds per square inch. The 18-inch stroke unit will discharge 88 gallons per minute at 7500 pounds per square inch up to 685 gallons per minute at 1000 pounds pressure per square inch. Other capacities and pressures are available. 73



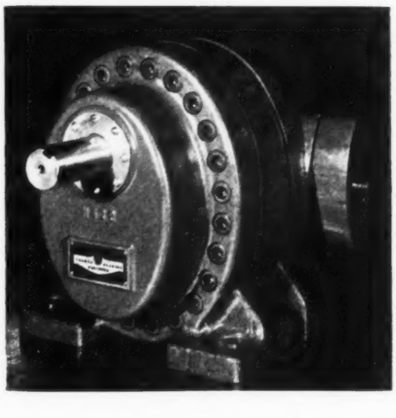
Baldwin-Southwark High-pressure "Triplez" Pump

Dayton Rogers Pneumatic Counterbalance Cylinders for Presses

The Dayton Rogers Mfg. Co., 2830 S. Thirteenth Ave., Minneapolis, Minn., has brought out a Model GT counterbalance cylinder designed to operate directly from the shop air-line system. This line of cylinders is built to counterbalance the heavy rams on the larger size straight-side presses, compensating for the increase or decrease in the size of the die tooling equipment fastened to the press ram. A combination regulator and air-pressure gage is furnished with each set of counterbalance cylinders. The cylinders (installed in groups of two, four, or six) automatically take up lost motion resulting from wear on the parts and on the large clutch mechanisms. 74



Dayton Rogers Counterbalance Cylinder



Hydro-Power Constant-delivery Gear Type Pump

Hydro-Power Gear Pump

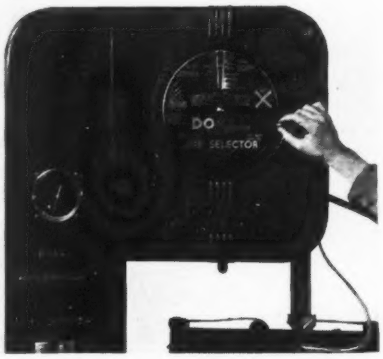
A larger size gear type hydraulic pump—the Model G-60—has been placed on the market by Hydro-Power Systems, Inc., Division of the Hydraulic Press Mfg. Co., Mount Gilead, Ohio. This pump is of the constant-delivery type, and will deliver 60 gallons of oil per minute at 1000 pounds per square inch line pressure. Precision spur gears of narrow width and large pitch diameter are used, which reduces both the hydraulic load on the gears and the distance between gear shaft bearings. This design also minimizes shaft deflection and makes it possible to obtain higher working pressure efficiently.

Hydro-Power gear pumps serve as prime movers for hydraulically operated machines requiring medium pressure and as drives for auxiliary units. They are also used in conjunction with high-pressure pumps to furnish large volumes of fluid at medium pressures for rapid traverse movements. The new pump is recommended for operation at 1000 pounds per square inch on applications where peak pressures are momentary, or for operation up to 500 pounds per square inch where peak pressures are maintained for any appreciable time. 75

Machinists' Tool Chests

The George Scherr Co., Inc., 128 Lafayette St., New York City, has recently placed on the market its own line of tool chests, which are available in solid oak, leatherette, and in low-priced poplar models. The open-top type of chest in this line has two locks, so that the open top and drawer section can be locked separately. A closed-top type is also available in the poplar model. 76

To obtain additional information on equipment described on this page, see lower part of page 226.



"Job Selector" Applied to DoAll Machine

DoAll "Job Selector"

Continental Machines, Inc., 1312 S. Washington Ave., Minneapolis, Minn., has developed a new "Job Selector" which it is applying to all DoAll contour sawing, filing, and polishing machines. This selector contains specific data on fifty-six basic materials, including ferrous and non-ferrous metals. By a simple movement of the hand, the selector will show at a glance the correct sawing speed, saw temper, saw pitch, and saw set required to obtain the most economical performance. The same information is also obtained in a similar manner when the machine is used for filing operations.

Additional information contained on the Job Selector covers oiling directions for the DoAll machine, and the minimum width of saw to be used in cutting contours of various radii. Light glare from the dial is eliminated by the curved face to permit distinct reading. 77

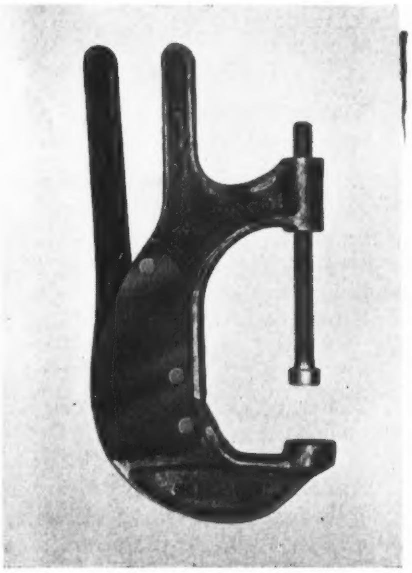
Gilmer-Hevaloid Belt

An endless belt for high-speed precision work, known as the "Gilmer-Hevaloid" belt, has been developed by the L. H. Gilmer Co., Tacony, Philadelphia, Pa. A unique process of impregnating the cotton pulling element with latex (U. S. and foreign patents) is said to form a material that is virtually homogeneous, resulting in special qualities of elasticity, strength, and durablity.

Made without lap, seam, or splice, the belt is free from vibration in operation. The Gilmer-Hevaloid material has a high coefficient of friction, which permits lighter belt tension, and lessens the bearing load. This results in a higher and more uniform speed on drives for routing machines, winders, grinders, and similar equipment. Pliability for use over small pulley diameters and light weight adapt it for speeds up to 9000 feet per minute. 78

"Klampacto" Toggle-Action C-Clamp

An improved model of the toggle-action C-clamp brought out several years ago by Knu-Vise, Inc., 16841 Hamilton Ave., Detroit, Mich., is announced under the trade name "Klampacto." The clamp is equipped with two handles, which, when squeezed together, apply a holding pressure of 2000 pounds. The lower jaw swings clear of the work when released. This clamp is furnished with a threaded spindle and lock-nut or patented Kam-Lock adjusting rod for use when arc welding to avoid spatter. Three models are available with 5-, 6-, and 10-inch jaws. 79



"Klampacto" Hand-operated C-clamp

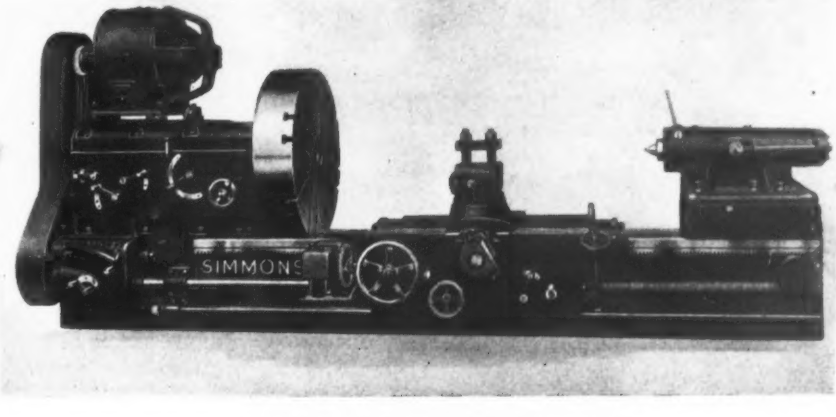
Simmons 48-Inch Heavy-Duty Engine Lathe

The Simmons Machine Tool Corporation, 1600 N. Broadway, Albany, N. Y., is now manufacturing a 48-inch heavy-duty engine lathe. The actual swing over the bed is 50 inches, and the swing over the carriage 36 inches. The distance between centers, with a 20-foot bed, is 126 inches. Power and hand feed are provided for lateral, cross, and angular movements. The compound rest has graduated angular movements and is equipped with massive straps and bolts for clamping the tools.

The nine spindle speeds obtained through sliding gears and a heavy clutch range from 1.9 to 112 R.P.M., using a direct-current motor having a speed range of 500 to 1200 R.P.M. With a constant-speed motor of alternating or direct current operating at a speed of 1200 R.P.M., the speed range is from 4.6 to 112 R.P.M.

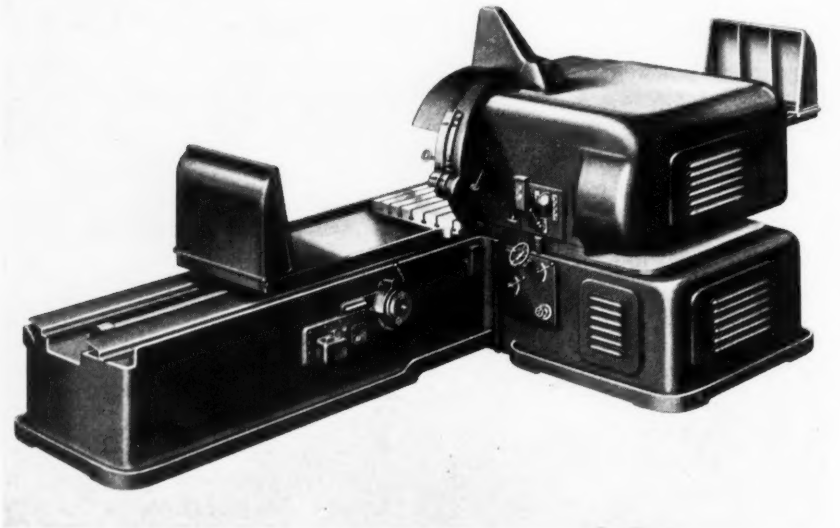
The spindle has a hole 2 3/4 inches in diameter through the center, and takes a tool with a No. 7 Morse taper shank. The head is fully enclosed, and all bearings and gears are constantly lubricated by a pressure oil-pump system provided with a filter. The tailstock spindle travel is 20 inches. The number of thread and feed changes provided by the feed-gear box is 32, and any number of threads from 1 to 14 can be cut. The regular range of feeds per revolution of the work is from 0.021 to 0.296 inch. The motor horsepower range recommended is 30 to 80.

Extra equipment, such as second carriages, motor-driven power rapid traverse, mechanical and electrical apron controls, extra capacity steady-rests, taper attachments, oil pans, pump, and piping, and various other units can be supplied. 80



Simmons Heavy-duty Engine Lathe

To obtain additional information on equipment described on this page, see lower part of page 226.



"Philadelphia Type" Face Grinding Machine

Diamond Face Grinding Machine

The Diamond Machine Co. of Philadelphia, 2447 Aramingo Ave., Philadelphia, Pa., has developed a face grinding machine known as the "Philadelphia Type," which is available in two sizes. The chief advantage claimed for this machine is increased speed of production. One of the most important features of design is the centralization of control, every lever, wheel, push-button, and instrument dial being brought to one location within easy reach of the operator. Other improvements include a longer bed, the length being such that even at the extreme limit of travel the platen never overhangs; and ways that are spaced wider apart to assure a more rigid foundation for the table. The platen has also been widened to accommodate a magnetic chuck or to permit grinding wider parts.

The table is driven by pistons mounted in double opposed cylinders, the rods of which are always in tension. This equipment, driven by a Hele-Shaw pump and known as the "fluid tension drive," provides uniform table speed in both directions of travel.

The wheel-head can be rotated horizontally through 15 degrees for concave grinding. The smaller machine uses a 30-inch wheel, and the larger machine a 36-inch wheel. The sectional abrasive blocks are chucked firmly against a solid rim. The main spindle drive is by V-belts. 81

Forest City Radius Forming Tool

A radius forming tool with tool-holder designed for the smaller size cutters has been added to the line of the Forest City Bit & Tool Co., Rockford, Ill. This new holder—No. 0—will take 3/16-, 1/4-, 5/16-, 3/8-, 7/16-, and 1/2-inch diameter cutters, forming a radius of 3/32, 1/8, 5/32, 3/16, 7/32, and 1/4 inch. Special size cutters can also be furnished. Each cutter is so designed that the radius will remain the same, regardless of the number of times it is sharpened. The tool-holder is 1 by 5 by 1/2 inch in size, and is designed for use in a lathe or shaper. 82

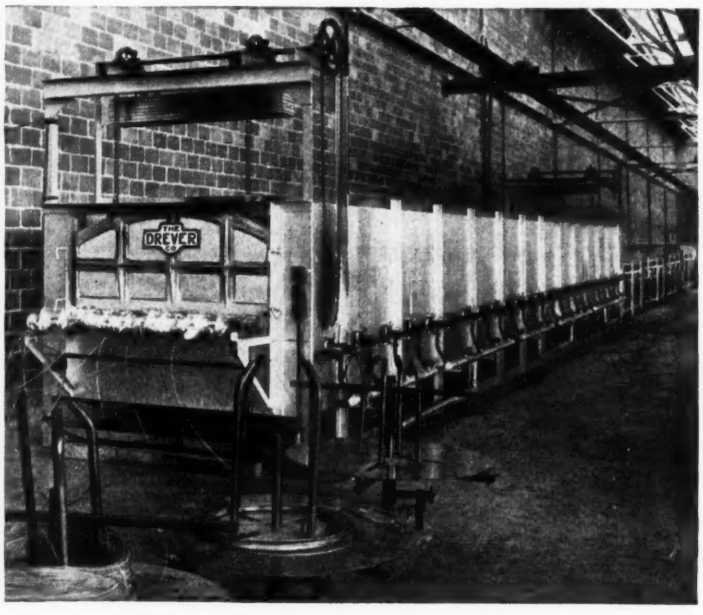
Drever Wire Annealing Furnace and Ammonia Dissociator

The annealing furnace here illustrated is manufactured by the Drever Co., 748 E. Venango St., Philadelphia, Pa. This furnace is producer gas-fired and is designed for continuously bright-annealing stainless-steel wire. It is equipped with thirty alloy muffle tubes in which the wire is continuously heated in a pure dry gas atmosphere. Heating is by high-pressure inspirator gas burners, and zone control of heating is accomplished by potentiometer type control pyrometers.

The furnace is lined with refractory brick backed up by block insulation, graded according to temperature requirements. The entire unit, including the reeling mechanism, occupies a floor space about 10 feet wide by 300 feet long. The gas generating and purifying system occupies an additional space of approximately 6 by 25 feet.

This company also manufactures an ammonia dissociator which provides a protective atmosphere for metal heat-treating furnaces. For annealing or bright-hardening and brazing, anhydrous ammonia, when dissociated by this equipment, gives an ideal hydrogen-nitrogen furnace atmosphere that eliminates surface oxides and intergranular oxidation. The dissociator is an electrically heated vertical cylindrical furnace, refractory lined, and surrounded by heat-insulating material encased in a fabricated steel shell.

With this equipment, it is possible to obtain 4500 cubic feet of mixed gases, of which about 3400 cubic feet is pure hydrogen, from only 100 pounds of ammonia. 83



Drever Furnace Developed for the Bright-annealing of Stainless-steel Wire

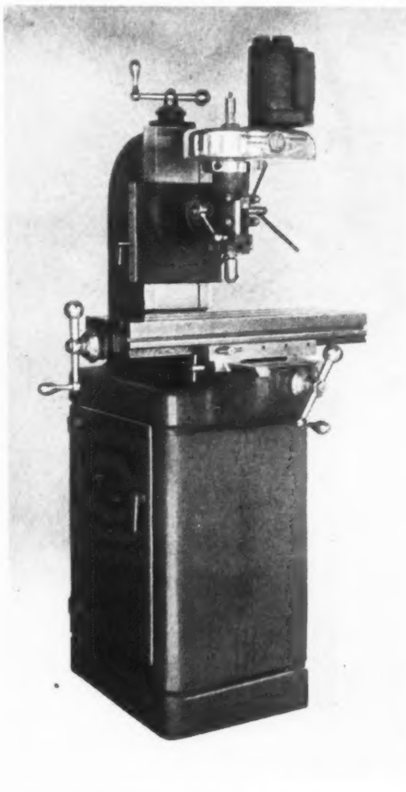
To obtain additional information on equipment described on this page, see lower part of page 226.

Holland Vertical Milling Machine

A new type of high-speed vertical milling machine known as the "Holland," is being placed on the market by Marburg Brothers, Inc., 90 West St., New York City. This machine is especially adapted for work on tools, dies, molds, and for accurate production work. The table remains at a fixed height, an advantage when fine work is being done, as it permits the operator to sit where he can observe the work closely and be within convenient reach of the table feed-screw handles.

The high-speed head is a self-contained motor-driven unit with graduations that permit it to be set to any angle up to 90 degrees in either direction from the vertical. The quill is lever-fed, and is provided with a depth stop graduated in thousandths of an inch. The spindle will accommodate a No. 7 B & S taper.

The longitudinal hand feed for the table is 16 inches, and the cross-feed range 8 inches. The head has a vertical movement of 8 inches, the maximum distance from the spindle to the table being 11 inches. The table has a working surface of 8 by 26 inches. The seven spindle speeds range from 525 to 4000 R.P.M. The machine weighs 900 pounds, and occupies a floor space of 49 by 34 inches. 84

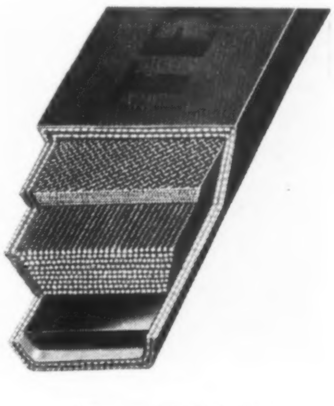


Vertical Milling Machine Placed on the Market by Marburg Brothers

Allis-Chalmers "Super 7" V-Belt

The Allis-Chalmers Mfg. Co., Milwaukee, Wis., has just brought out a V-belt in which fundamental improvements in structure have been incorporated to provide increased strength and flexibility, greater service, and longer life. All Tex-rope V-belts made by this company are now of the new "Super 7" laminated design.

The cords in these new belts are smaller, permitting the use of more cords per belt to obtain greater strength and less stretch. Each cord is individually embedded in heat-dissipating rubber to reduce internal degeneration of the belt.

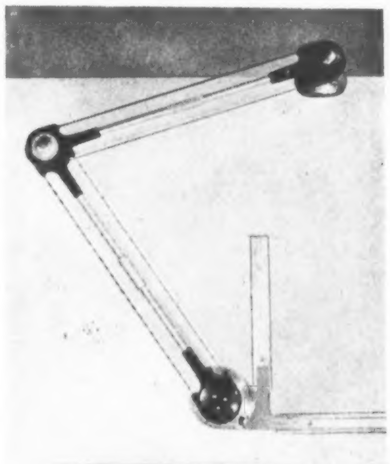


"Super 7" V-belt

The belts are made in matched sets to insure uniform, smooth-running qualities. The live rubber bottom cushion is intended to absorb the ceaseless impacts of operation; the central portion transmits power at the effective pitch diameter; and the bias-cut fabric prevents "dishing" and assures transverse stability. The two-ply rubber-impregnated fabric cover prevents destructive agents from reaching the vital elements. 85

Veeco Drafting Machine

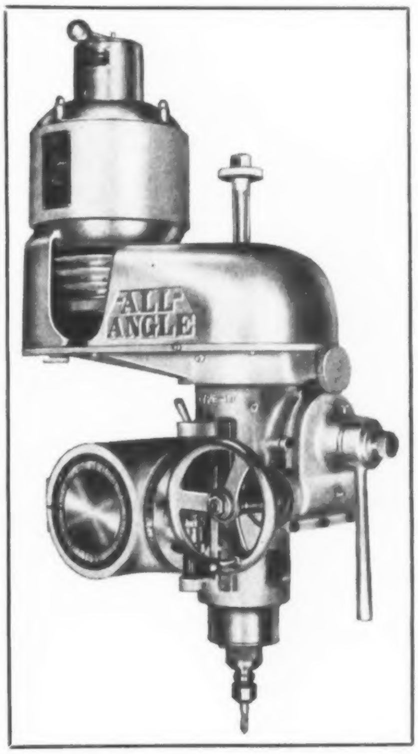
A drafting machine of simple and durable construction has been placed on the market by the V. & E. Engineering Co., Pasadena, Calif. The indexing mechanism is readily released or locked by a thumb-piece in the handle. An elbow brake, adjusted by a single thumb-screw, prevents sliding on an inclined table. The arms are so articulated that the head of the machine readily adjusts itself to any irregularities in the drawing surface; 24-inch scale arms are regularly provided, but 30- or 36-inch arms are available. The engine-divided circular scale is 4 3/4 inches in diameter and has a double vernier reading to 5 minutes. 86



Drafting Machine Manufactured by V. & E. Engineering Co.

Fray "All-Angle" Full-Universal Milling Attachment

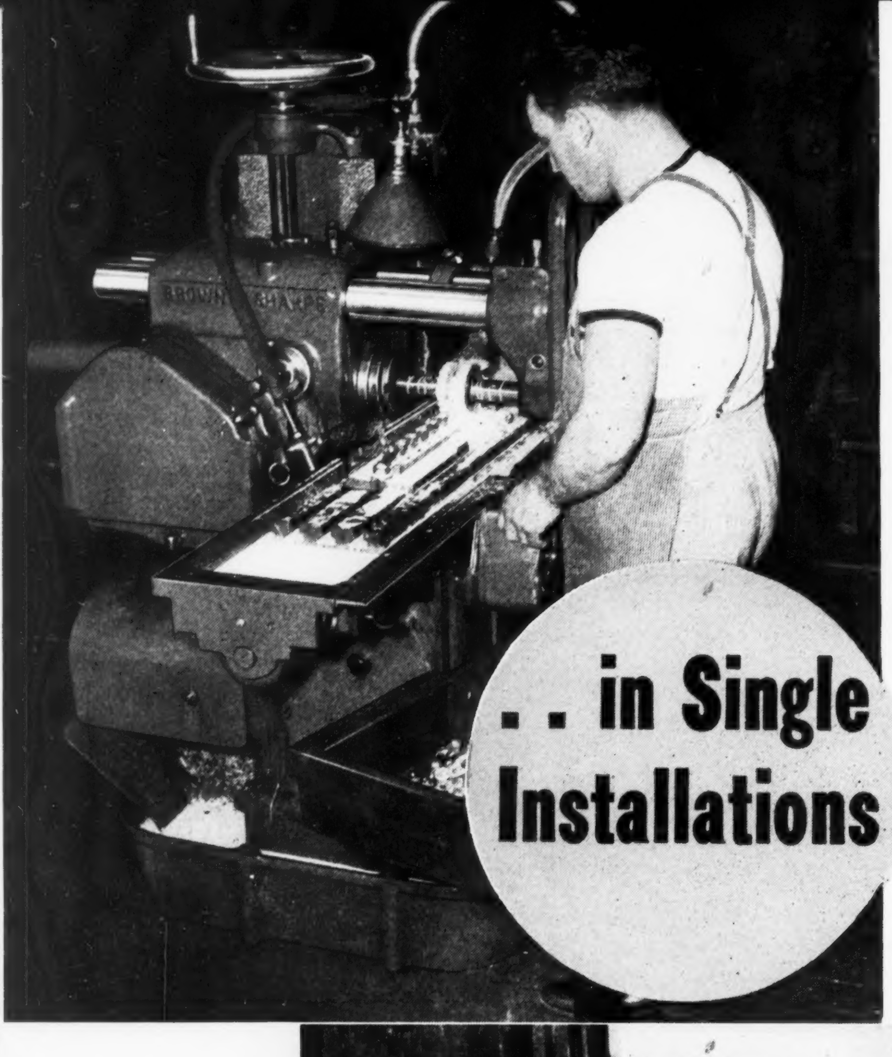
A Type D "All-Angle" full-universal milling attachment is being placed on the market by the Fray Machine Tool Co., 515 W. Windsor Road, Glendale, Calif. Two squaring faces are machined on the hous-



Fray Universal Milling Machine Attachment

To obtain additional information on equipment described on this page, see lower part of page 226.

No 12 PLAIN

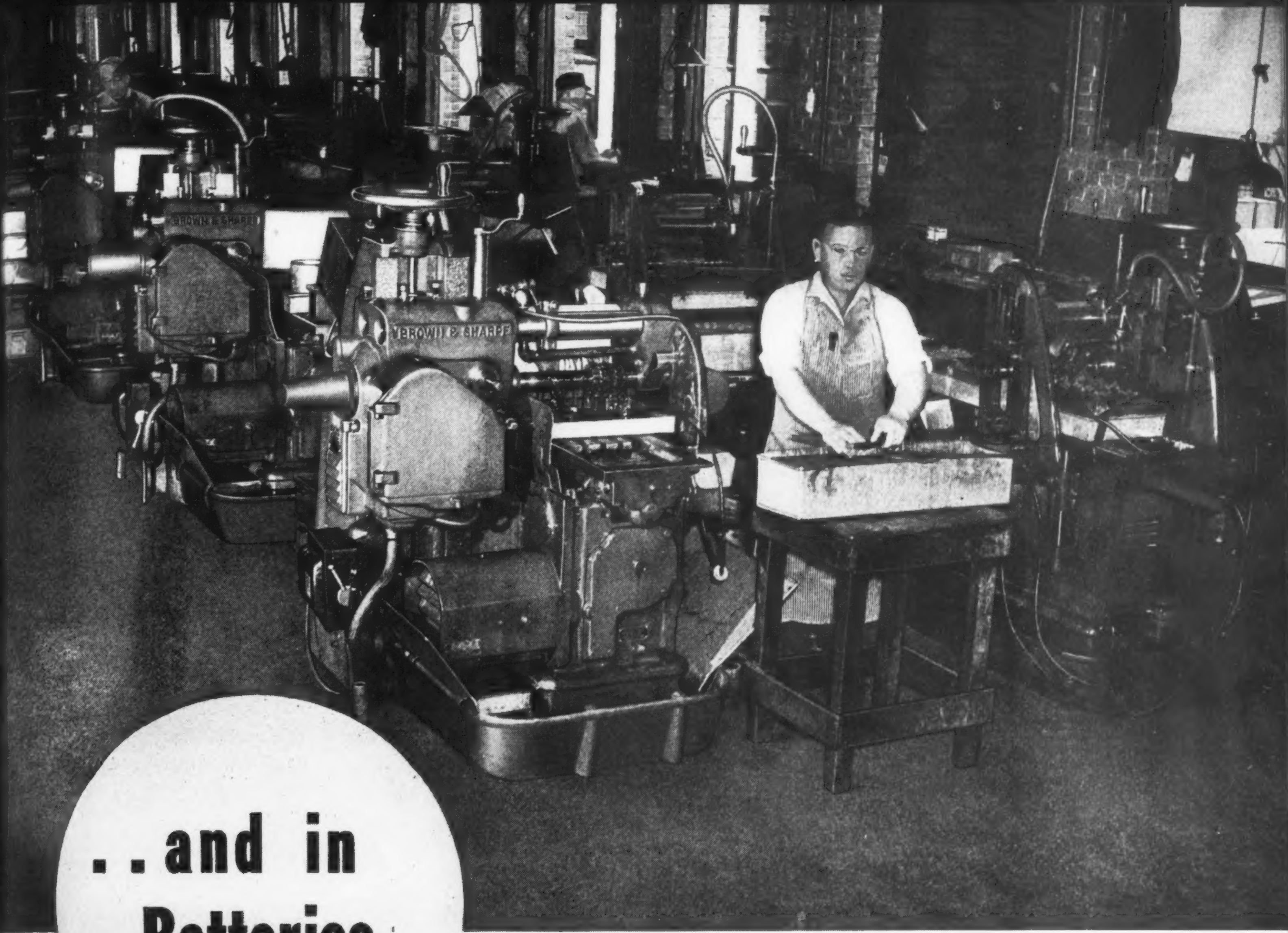


.. in Single Installations

.. in Small Groups

B·S

BROWN &


BROWN & SHARPE
BROWN & SHARPE

ing of the attachment for convenience in setting it square with the machine table. One-sixteenth inch graduations are provided on the housing for use with a depth stop.

The spindle has six splines, is hardened and ground, and is drilled for a draw-in bolt. The collet can be tightened either by hand or with a wrench. The spindle is fitted with radial thrust ball bearings and has a travel range of 3 1/2 inches. It is furnished with either No. 7 B & S or No. 2 Morse taper. Six-step pulleys give speeds ranging from 375 to 5200 R.P.M. The ball-bearing motor swings completely around the housing, and can be locked in any position.

The quill is hardened and ground, and is compensated for to obtain extreme sensitivity. The attachment can be instantly changed from micrometer wheel feed to hand-lever feed, or vice versa. The micrometer depth stop has ground screw threads and large adjusting nuts with easily read graduations. This stop can be positively locked at any point. 87

Williams Midget Type Reversible Ratchet Wrench

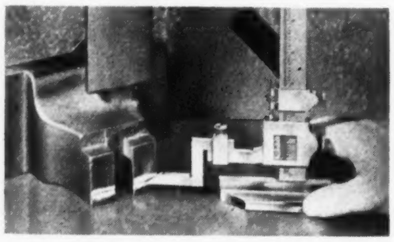
Williams Midget Reversible Ratchet Wrench

J. H. Williams & Co., 225 Lafayette St., New York City, have recently added a midget pattern ratchet wrench to their "Supersocket" line. This wrench has a 1/4-inch square drive, and is 4 1/2 inches long. It has the same patented double-tooth pawl for both "on" and "off" rotation used in other "Superratchet" wrenches.

A shift lever at the head instantly reverses the ratchet action. The handle is drop-forged from high tensile strength carbon steel. Working parts are machined from chrome-molybdenum steel, and are heat-treated. The wrench is finished in chromium plate over nickel. 88

B & S Offset Markers for Vernier Height Gages

The Brown & Sharpe Mfg. Co., Providence, R. I., has added two offset markers (Nos. 585C and 585D) to its line of precision tools. These markers are designed to increase the usefulness of B & S No. 585 vernier height gages. With them, measurements can be taken as low as the plane of the surface on which the height gage is placed, as well as in shallow recesses.

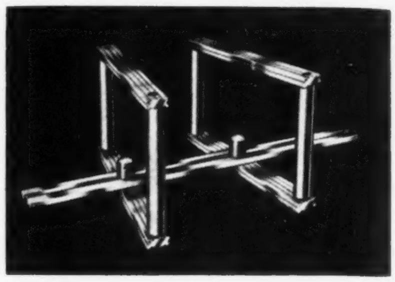


Vernier Height Gage Equipped with New B & S Offset Marker

When used in the normal inverted position, they extend the range of the height gage beyond the normal range of a gage equipped with a straight marker. The marker arm is made unusually long to facilitate measuring projections. These markers are available in two sizes — 3 inches long, for use with B & S 10-inch vernier height gages, and 4 inches long, for use with 18- and 24-inch vernier height gages. 89

Acro Die Cradle

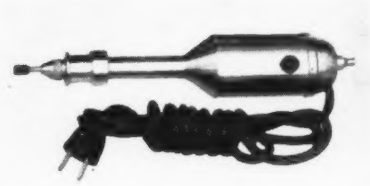
The Acro Tool & Die Works, 2815 Montrose Ave., Chicago, Ill., has brought out a universal parallel unit designated the "Acro Die Cradle" for use in supporting dies, jigs, and metal parts while drilling, counterboring, tapping, milling, or grinding. Two thumb-screws permit a quick adjustment in length up to 20 inches. The standard height of the parallels is 7 inches. This cradle is made of high-grade steel, hardened and ground to close tolerances. 90



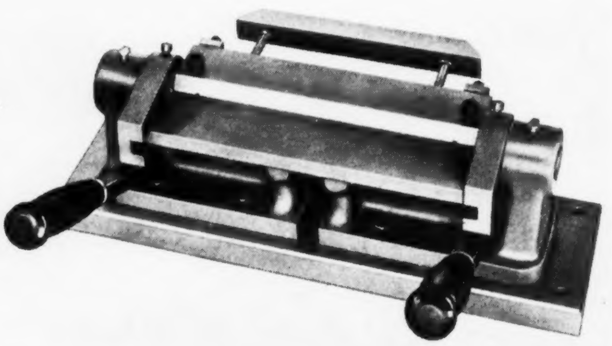
Acro Die Cradle for Tool and Die Shops

Electric Hand Finishing Tool

An electric hand tool designed for grinding, polishing, drilling, routing, carving, and other finishing operations has been placed on the market by Small Motors, Inc., 1733 Milwaukee Ave., Chicago, Ill., under the trade name Super De Luxe Eagle Model. The construction of the tool permits it to be mounted on a lathe for grinding small holes. The spindle has two ball bearings, and a rear self-aligning bronze bearing. It rotates at 30,000 R.P.M. The tool operates on 110-volt alternating or direct current. 91



Hand Finishing Tool Made by Small Motors, Inc.

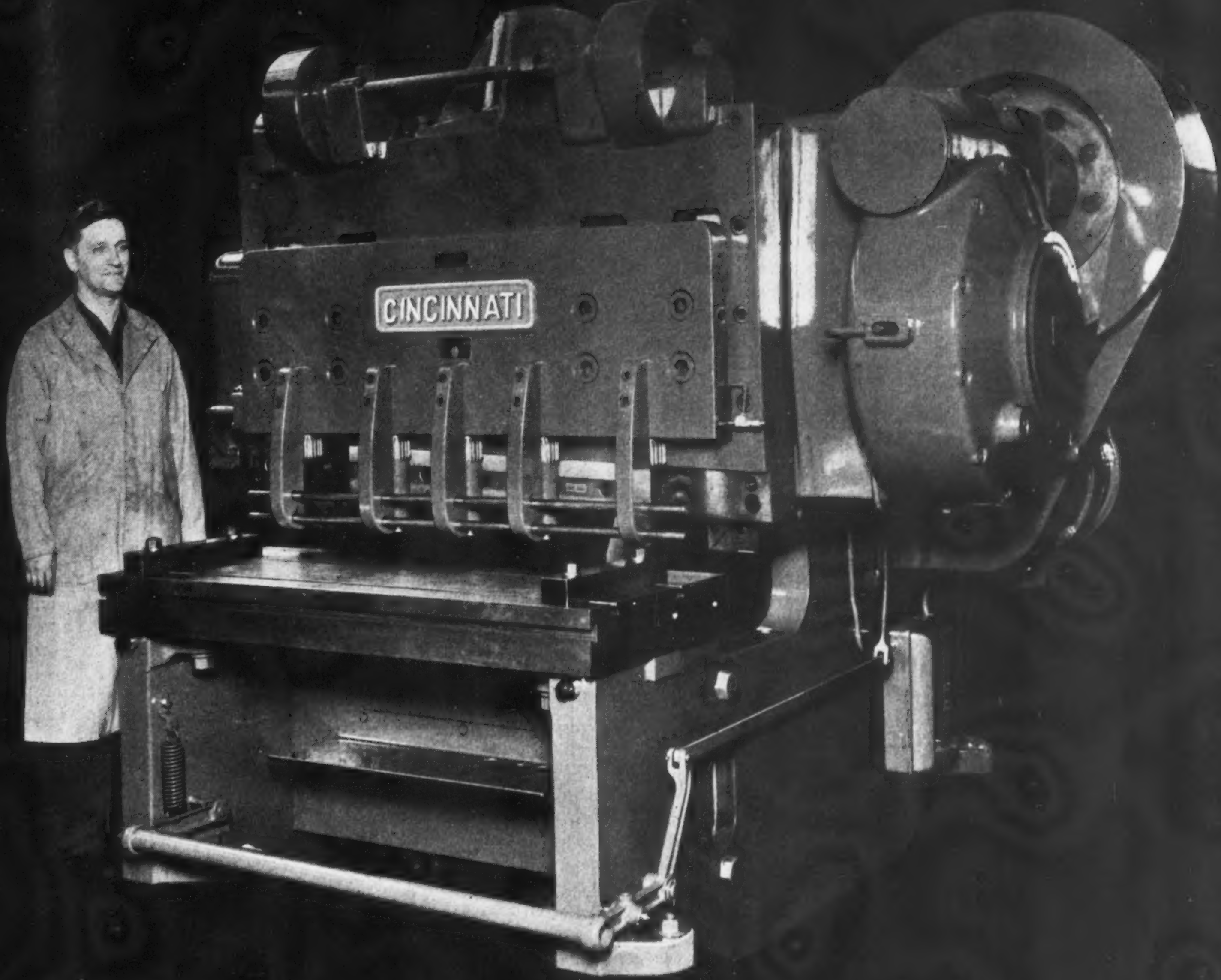


Micro Metal Folding Brake Made by the O'Neil-Irwin Mfg. Co.

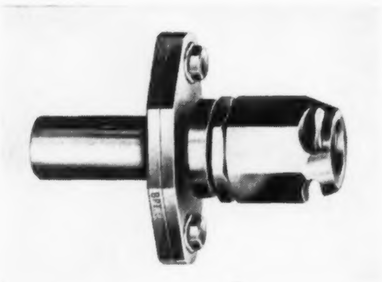
Die Duplicating Brake

The No. 2 Micro die duplicating brake here illustrated is the latest addition to the line of sheet-metal working equipment made by the O'Neil-Irwin Mfg. Co., 316 Eighth Ave., S., Minneapolis, Minn. This

To obtain additional information on equipment described on this page, see lower part of page 226.


CINCINNATI

brake is designed for working steel and non-ferrous materials such as are used in the manufacture of aircraft and electrical instruments. It will fold 14-gage steel plate up to 8 inches wide when operated by both handles simultaneously, and 18-gage steel plate when operated by one handle. Heavier gages of other more ductile materials can also be worked. The maximum angular folding capacity is 110 degrees. The brake weighs 60 pounds, and is designed to handle a wider range of work than the previous 6-inch model. 92



Alco Releasing Die-holder for Hand Screw Machines and Turret Lathes

Alco Releasing Die-Holder

The Alco Tool Co., 835 Housatonic Ave., Bridgeport, Conn., has recently started production on a releasing model Acorn type die-holder for hand screw machines and turret lathes. The outstanding features are adjustable concentric alignment and rigid drive. It is designed to produce accurate work, even when used on old lathes having badly worn turrets and bearings. A ground bearing surface in the nut makes contact with a similar ground surface on the body to assure accurate alignment of the die, regardless of the thread fit. This provides for quick and positive alignment of the die concentric with the work. 93

* * *

To prevent a shortage of steel, the James F. Lincoln Arc Welding Foundation, Cleveland, Ohio, advises wider use of welded construction. Figures just released by the Foundation indicate that, on an average, 18 per cent less steel is required to build many products by welding than by methods formerly employed. The Foundation quotes a number of outstanding examples of savings in steel tonnage made through welding such equipment as locomotive frames, freight cars, bridges, buildings, etc.

Aluminum Required for Defense Purposes

A few facts about the aluminum situation in the United States may prove of interest. Due especially to the increasing airplane production, there has been, and will be, an unprecedented demand for aluminum. At present, there is no shortage of aluminum for national defense, but civilians' uses have been materially curtailed. Manufacturers of peacetime goods are being forced to use substitutes for aluminum for the duration of the war.

How long it will be true that there is no shortage of aluminum for national defense is problematical. Depending largely on the rapidity of the acceleration of plane production in the United States and in Great Britain, there may be a shortage even within a month, or within six months, or a year. Mr. Knudsen, for example, has said that the expanded plane program will require an annual production of 1,600,000,000 pounds of aluminum. The best available estimates indicate that this is more aluminum than the whole world produced in 1940.

In 1939, for which complete statistics are available, the aluminum production in the United States was 327,000,000 pounds. Domestic production at present is at the rate of 600,000,000 pounds annually. By July, 1942—that is, a year from now—the production will reach approximately 825,000,000 pounds a year. The Aluminum Co. of America was, until recently, the sole producer of primary aluminum in this country. By July, 1942, this company will have completed an expansion program, required by national defense needs, which will more than double the productive capacity previously built up over fifty years of operation. To do this, the company will have expended some $200,000,000, all through its own financing.

The most recent addition to the company's facilities are the Washington Works at Vancouver, Wash. Here, less than fifteen months ago, the site of these works was a cow pasture. Today, the capacity is more than 150,000,000 pounds annually. This figure is highly significant when one remembers that the total production of all aluminum in the United States did not exceed 130,000,000 pounds a year in the last World War. In fact, the entire industry in the United States did not produce 150,000,000 pounds until 1924. Yet the Vancouver Works will account for but one-fifth of the metal to be produced by the company by July, 1942.

Worthington Employes Honored for Long Service

In appreciation of long and loyal service, H. C. Beaver, president of the Worthington Pump & Machinery Corporation, Harrison, N. J., recently distributed more than 2800 lapel emblems to employes who have been with the company for five or more years. Nearly one-half of the total number of workers employed were included in this group. Not less than eleven have been employed for over fifty years; in the twenty-five to twenty-nine year class, there were about two hundred; and in the thirty to thirty-nine year class, fifty-four.

* * *

Wear-resistant nickel alloy steels, including both a high-carbon nickel-chromium-molybdenum steel, and the modified Hadfield (13 per cent manganese, 3 per cent nickel) cast composition are being more and more used for power shovels for mining.

Sixth Annual Plastics Competition

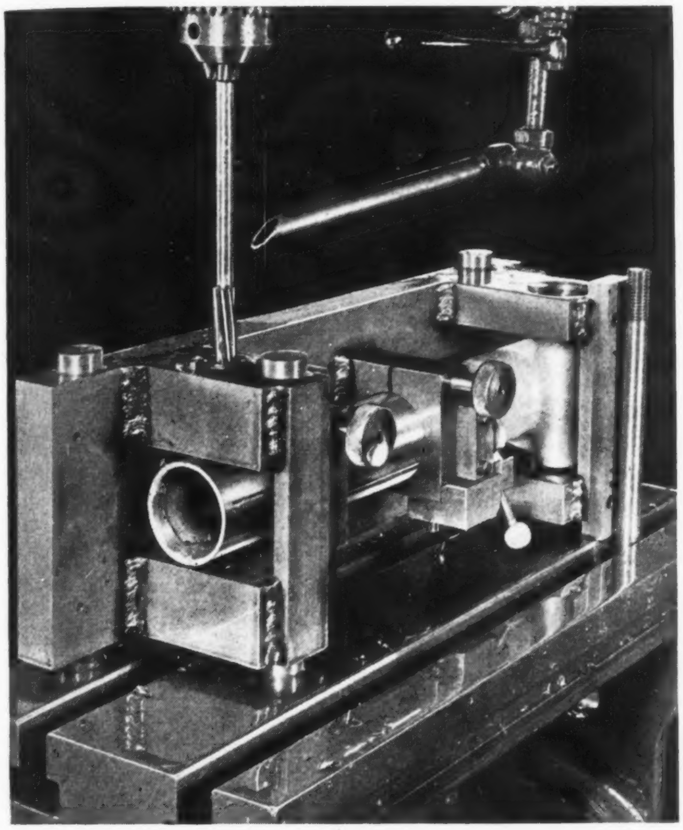
The sixth annual plastics competition sponsored by the magazine *Modern Plastics* has become one of the important events in the plastics industry. On account of the importance of plastics under present industrial conditions, when many metals have been set aside entirely for defense industry use, this competition assumes additional significance. All plastic-using firms, designers, molders, fabricators, material suppliers, builders of plastics machinery, and diemakers are invited to participate. Any plastic object or product will be deemed eligible if it has been designed or has been placed on the market since September 1, 1940. Because of the outstanding developments in plastics, a revision and expansion of classifications had to be made this year. Additional information can be obtained by addressing *Modern Plastics*, 122 E. 42nd St., New York City.

To obtain additional information on equipment described on this page, see lower part of page 226.

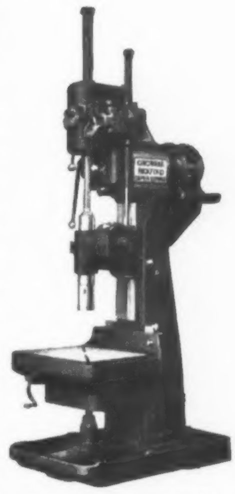
CINCINNATI BICKFORD

SUPER SERVICE Radials and Uprights

are Profitable Aircraft Production Tools . . .

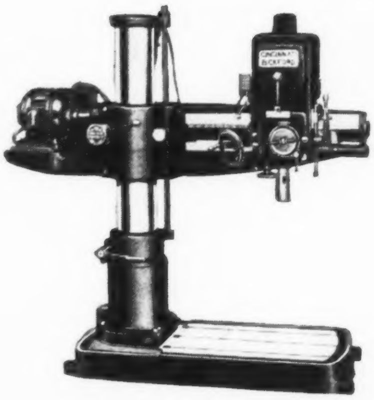


AT THE CONSOLIDATED AIRCRAFT PLANT the Super Service Upright is extensively applied to production drilling—to accurate and speedy reaming, spotfacing and similar operations. Illustrated is the Super Service Upright in the Consolidated Plant, performing on a Dural casting for an airplane wing fitting. Jobs like these must be finished to perfection, and the Super Service Upright delivers the required speed, proficiency and economy. Some of the Cincinnati Bickford features are: single lever control of speed and feed changes—direct reading speed and feed plates—multiple splined integral key construction — heat treated alloy steel gears with ground teeth—and many others. Illustrated catalogs sent upon request.



21", 24" and 28" Sizes, Round or Box Column

AT THE DOUGLAS AIRCRAFT PLANT the Super Service Radial is considered one of the most dependable and versatile tools. Here this popular machine completes with speed and top-efficiency a large number and variety of drilling, reaming, tapping and kindred operations — as evidenced by the Douglas set-up shown above, which calls for the precise Super Service drilling and reaming of a steel bomb mechanism. In jobs of this sort, Cincinnati Bickford designs for a wide range of feeds and speeds, a thoroughly dependable accuracy, a fast and easy operation stand out as profitable advantages. Bulletin R-24 explains all features.

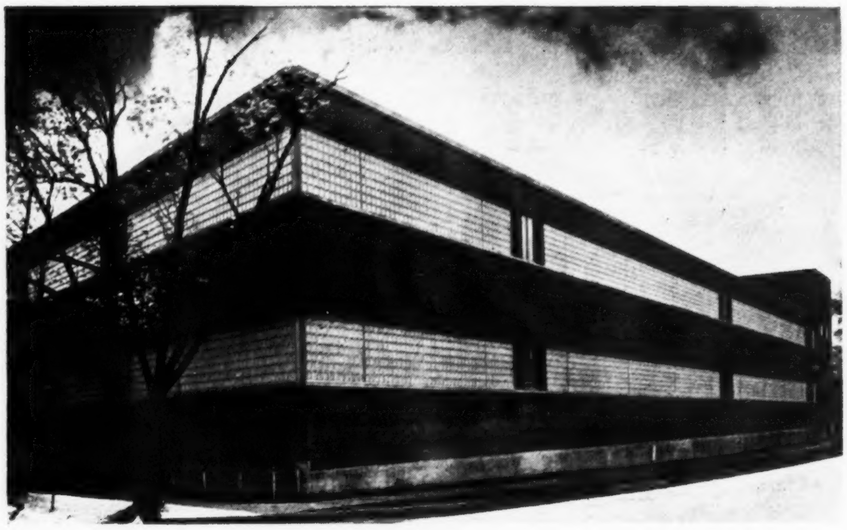


3' Arm, 11" Column to 8' Arm, 19" Column. Also 3' or 4' Arm, 9" Column

THE CINCINNATI BICKFORD TOOL CO.

OAKLEY · CINCINNATI · OHIO · U. S. A.

Greenfield Tap & Die Quadruples Gage Capacity



New Gage Plant of the Greenfield Tap & Die Corporation

A new gage manufacturing plant has been erected by the Greenfield Tap & Die Corporation, Greenfield, Mass., in cooperation with the Government. This plant, which is now in operation, will more than quadruple the company's production of gages.

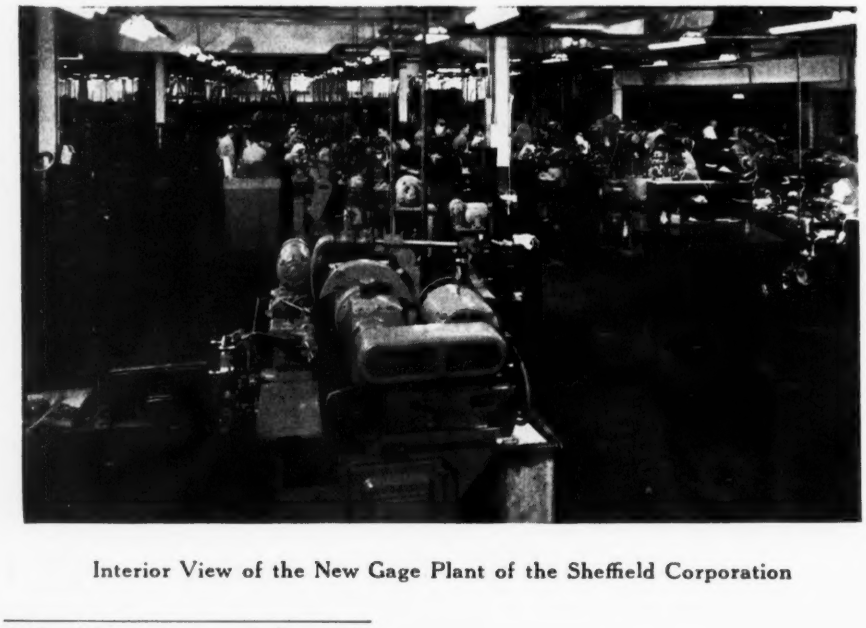
The building consists of two stories, 200 by 80 feet, of brick construction, with two tiers of glass brick on two sides. It is completely air-conditioned, with a temperature control that maintains an even temperature, with very slight variations, day and night. The final inspection room, 60 by 40 feet, is separately air-conditioned, and is maintained at a temperature of 68 degrees F. and 50 per cent relative humidity. Fluorescent lighting has been installed throughout the building, maintaining a uniform average intensity of 25 foot-candles, with intensities up to 65 foot-candles on special equipment and for final inspection.

The dedicatory exercises, held May 30, were attended by Brigadier General G. M. Barnes, Assistant Chief of Industrial Engineering Service, Office of the Chief of Ordnance, and by General Stewart, Commanding Officer of the Springfield Arsenal. A feature of the occasion was a presentation to General Barnes of the first set of gages made in the new plant.

Sheffield Corporation Opens New Gage Plant

The Sheffield Corporation, Dayton, Ohio, recently opened its new plant on Springfield St. of that city. The new building, together with its equipment, represents a total cost of approximately $1,000,000, and is designed to furnish gages of various styles and sizes for the defense industries throughout the United States. The new building is 80 by 240 feet in size, and contains about 35,000 square feet of floor space; approximately 650 men will be employed.

At the opening ceremonies of the new plant, a great many high Army officers were present, including Brigadier General G. M. Barnes, Assistant Chief of Industrial Engineering Service, Office of the Chief of Ordnance, and Brigadier General W. P. Boatwright, commanding officer of the Frankford Arsenal, Philadelphia, Pa.



Interior View of the New Gage Plant of the Sheffield Corporation

* * *

Pratt & Whitney Increases Gage Capacity

The Pratt & Whitney Division Niles-Bement-Pond Co., West Hartford, Conn., recently placed in operation its new gage manufacturing building which has been made necessary solely for the purpose of national defense requirements. The building covers an area of 48,000 square feet. Part of the new facilities extend the previous constant-temperature room so that this area now totals 16,800 square feet, in which the temperature is maintained at 68 degrees F., within 1 degree, night and day the year around.

The new gage building was recently dedicated in the presence of a great number of invited guests and the assembled employes of the gage division. Among those present were Brigadier General G. M. Barnes of the Ordnance Office, Washington, D. C., and several other officers of the Office of the Chief of Ordnance.

NEWS OF THE INDUSTRY

California

M. & H. Hose Reel Co., 5202 Alhambra Ave., Los Angeles, Calif., has been formed for the manufacture of M & H hose reels, which employ a different principle to turn the reel for rewinding the hose than has previously been used on self-rewinding reels. These reels find applications in manufacturing plants, machine shops, etc., for blow guns, air tools, air hoists, paint spraying, gas welding, and other uses.

Illinois

D. L. Davis has been appointed factory manager in charge of engineering and production in the pump division of the Tuthill Pump Co., Chicago, Ill. Mr. Davis was formerly tool engineer of the Savage Arms Corporation; chief engineer of the Teetor Adding Machine Co.; factory manager of the W. A. Sheaffer Pen Co.; consulting engineer of the Trundle Engineering Co.; and assistant works manager of the Hurley Machine Co.

H. S. Simpson, of the National Engineering Co., Chicago, Ill., has been elected president of the American Foundrymen's Association; D. P. Forbes, of the Gunite Foundries Corporation, Rockford, Ill., has been elected vice-president; and C. E. Westover, of the Burnside Steel Foundry Co., Chicago, Ill., has been appointed executive vice-president and treasurer.

Hollis U. Gordon and Chester L. Glover have opened sales offices at 565 West Washington Blvd., Chicago, Ill., as agents, respectively, for the National Broach & Machine Co., Detroit, Mich., and the Cone Automatic Machine Co., Windsor, Vt. They will be assisted by C. E. Hartley.

E. W. Cristener has been appointed sales manager of the Chicago Reinforcing Bar Division of Joseph T. Ryerson & Son, Inc., Chicago, Ill. Mr. Cristener became associated with the Ryerson company in 1922. He has had many years experience in drafting, estimating, engineering, and designing of concrete reinforced structures.

Frank F. Trierweiler has been appointed manager of the Concrete Reinforcing Division of Joseph T. Ryerson & Son, Inc., Chicago, Ill., to take the place of E. S. Langdon, who died on May 1. Mr. Trierweiler is a graduate of the University of Michigan, 1915. He became associated with Joseph T. Ryerson & Son. Inc., in 1924.

V. P. Rumely has been elected vice-president in charge of manufacturing of the Crane Co., Chicago, Ill., succeeding J. H. Collier who has become president of the company. Mr. Rumely has been works manager of the Crane Co.'s Chicago plant for the last four years. Previous to that time, he was superintendent and factory manager of the Hudson Motor Car Co., Detroit, Mich.

V. P. Rumely, Vice-president in Charge of Manufacturing of the Crane Co.

D. H. Skeen & Co., 1 N. LaSalle St., Chicago, Ill., have been appointed distributors for the Walker "Hole Hog" boring-bar holder.

Indiana

James H. Maquire has retired from active duty as works manager of the Haynes Stellite Co., Kokomo, Ind., a unit of the Union Carbide and Carbon Corporation, but will continue with the company in a consulting capacity. F. T. McCurdy has become general superintendent in charge of production and operating departments. He has served as superintendent of plant since 1929. J. R. Brown, formerly production manager, has become assistant superintendent.

Merz Engineering Co., Indianapolis, Ind., has started operations in a new plant at 200 S. Harding St. The building is of modern brick and steel construction, with 36,000 square feet of floor space. The company manufactures gages, jigs, fixtures, and special machine tools. It employs 200 people, and expects to double that number within a couple of months.

S. G. Taylor Chain Co., Hammond, Ind., has just celebrated its sixty-eighth anniversary in the chain-making business. E. Winthrop Taylor, president of the company, is the grandson of S. G. Taylor, Sr., who, in 1873, started this business, which has had an unbroken succession of father-and-son management for three generations.

Michigan

J. H. Coyle has been made assistant sales manager of the Murchey Machine & Tool Co., Detroit, Mich. Mr. Coyle has been with the Murchey organization for fifteen years, having acted as service representative, service engineer, and sales representative. Previous to becoming connected with the Murchey Machine & Tool Co., Mr. Coyle was employed in the engineering departments of the General Motors Corporation and the Hudson Motor Car Co.

Herbert J. Braun, formerly with Foote Bros. Gear & Machine Corporation, Chicago, Ill., has been appointed Detroit sales representative for Kennametal steel cutting carbide tools and blanks by McKenna Metals Co., Latrobe, Pa. He will be located at the Detroit office, 14425 Mark Twain Ave., of which John S. Roney is in charge.

A. C. Haberkorn Machine Co., 412 New Center Bldg., Detroit, Mich., has been appointed exclusive agent for the Kent-Owens Machine Co.'s milling machines in Detroit and eastern Michigan.

Lloyd J. Lee, formerly with the Wilcox-Rich Division, Eaton Mfg. Co., has been elected vice-president of the Gordon-R-Co., 625 Washington Square Bldg., Royal Oak, Mich., manufacturer of Plan-O-Mill thread and form milling machines. Mr. Lee will have charge of sales and engineering. The Gordon-R-Co. has purchased the manufacturing rights and business of the Plan-O-Mill Tool Corporation of New York City.

New England

Production Machine Co., Greenfield, Mass., has taken over the manufacture of the line of plain and universal tool and cutter grinders formerly manufactured by the Greenfield Tap & Die Corporation. These machines are now being built in three types as follows: No. 190, the lightest type; No. 2, standard machine with countershaft drive; and No. 3, machine with motor-in-the-head drive. The company is now scheduling orders for early fall delivery.

ALDEN F. ERIKSON, for the last seven years district manager of sales for the Wyckoff Drawn Steel Co. in the Boston and New England territory, has been called for active duty in the Coast Artillery, in which he holds the rank of major. THEODORE C. CEDERHOLM will succeed him as district sales manager. Mr. Cederholm has been with the Hawkridge Brothers Co., Boston, Mass., for the last seven years.

R. M. CLEVELAND, for twenty-four years with the Worthington Pump & Machinery Corporation, Harrison, N. J., has been appointed manager of the Worthington Boston office, succeeding W. A. FINN, who has been called to active duty as a lieutenant in the Navy. Mr. Finn has been with the Worthington organization since resigning his commission as a Naval officer in 1926.

HARTLEY WIRE DIE CO., Thomaston, Conn., has doubled its factory floor space to accommodate new equipment for the production of Carboloy dies. This expansion will permit production of all types of special Carboloy dies, including those used in the manufacture of bullets, shells, and other armament parts, in addition to the wire-drawing dies normally made by the company.

New Jersey

MANHATTAN RUBBER MFG. DIVISION OF RAYBESTOS-MANHATTAN, INC., Passaic, N. J., recently unveiled a memorial on the lawn of its office building to Colonel Arthur Farragut Townsend, one of the founders of the Manhattan Rubber Mfg. Co., and its president for twenty-six years. In 1929, when the Manhattan Rubber Mfg. Co., the Raybestos Co., and the United States Asbestos Co. were merged, he became chairman of Raybestos-Manhattan, Inc., which position he held until his death in 1940. The base of the memorial bears this inscription: "He has achieved success who has gained the respect of intelligent men; who has filled his niche and accomplished his task; who has left the world better than he found it; who has always looked for the best in others, and given the best he had; whose life was an inspiration, whose memory a benediction."

A. W. PARKER has retired, after fifty-four years of continuous service with the Worthington Pump & Machinery Corporation, Harrison, N. J. He became connected with the Worthington organization in 1887 as a draftsman, and served for many years as mechanical engineer and product designer. He made important contributions of a variety of pumping machinery. Later he was also engaged in the publicity and advertising department of the company. Recently Mr. Parker was honored as one of a group of eleven men who were awarded diamond-studded emblems for having completed more than a half-century of continuous service.

MANHATTAN RUBBER MFG. DIVISION OF RAYBESTOS-MANHATTAN, INC., Passaic, N. J., received the annual award of the National Advertising Agency Network for "the best advertising campaign in business papers" at a recent convention in Chicago. The Manhattan campaign—an unusually comprehensive one — ran in fifty-eight industrial and business magazines.

CLEVELAND AUTOMATIC MACHINE CO., Cleveland, Ohio, has removed the office maintained at 50 Church St., New York City, to the American Insurance Bldg., 15 Washington St., Newark, N. J.

New York

HOWARD M. GIVENS, JR., has been made manager of tool steel sales of the Allegheny Ludlum Steel Corporation,

Howard M. Givens, Jr., Manager of Tool Steel Sales, Allegheny Ludlum Steel Corporation

Pittsburgh, Pa., succeeding A. F. DOHN, who recently retired from active duty. For a number of years, Mr. Givens was employed in the research laboratory, rolling mills, and tool steel sales department of the Midvale Co., Philadelphia, Pa. In 1936, he became connected with the Allegheny Steel Co., and soon after the company's merger with the Ludlum organization in 1938, he became assistant manager of tool steel sales. Mr. Givens will make his headquarters at the Watervliet, N. Y., plant of the corporation, where the tool steel division is located.

J. G. GILBERT-LODGE, governing director of Gilbert Lodge & Co., Ltd., machinery and shop equipment dealers in Australia and New Zealand, with headquarters at Sydney, Australia, has come to the United States for the purpose of making connections with machine tool manufacturers. Mr. Gilbert-Lodge is especially interested in machines for the manufacture of every kind of munitions of war. He is also interested in high-speed, alloy, die, and carbon steels, and in tungsten- and tantalum-carbide cutting tools. Gilbert Lodge & Co., Ltd., have several offices in various parts of Australia and New Zealand, and already represent a number of the leading machine tool builders in the United States. Manufacturers who wish to communicate with Mr. Gilbert-Lodge while he is in the United States may do so in care of the Chase National Bank, 18 Pine St., New York City.

DR. A. M. ROTHROCK, of the National Advisory Committee for Aeronautics, has been selected to receive the 1940 Horning Memorial Medal, awarded annually by the Society of Automotive Engineers to the author of the best paper presented at its meetings relating to the adaptation of fuels to internal-combustion engines or the adaptation of internal-combustion engines to fuels.

J. ARTHUR DEAKIN has been appointed eastern district manager for the McKenna Metals Co., Latrobe, Pa., manufacturer of Kennametal steel-cutting carbide tools and blanks. Mr. Deakin will be in charge of the eastern sales office that the company has recently opened at 50 Church St., New York City, and will serve the New England states and northern New Jersey.

JESSE J. RICKS, formerly president of the Union Carbide and Carbon Corporation, 30 E. 42nd St., New York City, has been elected chairman of the board. BENJAMIN O'SHEA, formerly vice-president, has been made president. ROBERT W. WHITE, secretary and treasurer, has been made a vice-president.

MYRON POWERS has been made manager of purchases of the Chicago Pneumatic Tool Co., with headquarters at the general offices, 6 E. 44th St., New York City. He was formerly in charge of purchases at the company's Cleveland plant.

JOHN R. CASSELL CO., 110 W. 42nd St., New York City, is handling the line of drafting materials made by the FREDERICK POST CO., Chicago, Ill., in the metropolitan New York district.

ARMSTRONG-BLUM MFG. CO., Chicago, Ill., announces that the company's New York office has been moved to 225 Lafayette St., New York City.

Ohio

E. L. BATES has become director of sales for the Fostoria Pressed Steel Corporation, Fostoria, Ohio. Mr. Bates has been vice-president and a member of the board of directors for several years. He is a graduate of the Harvard Business School.

Howard F. MacMillin, president and general manager of the Hydraulic Press Mfg. Co., Mount Gilead, Ohio, was recently given a testimonial dinner at the Hotel Harding, Marion, Ohio, by a group of thirty of his close business associates and friends, including residents not only of Mount Gilead, but of Marion, Dayton, and Columbus, Ohio; Detroit, Mich.; and Chicago, Ill. As an evidence of the esteem of his associates, Mr. MacMillin was presented with a gold watch.

Clover Mfg. Co., Norwalk, Conn., manufacturer of coated abrasives such as flint, garnet, emery, silicon carbide, and aluminum oxide, has appointed Daniel V. Maher factory representative for the state of Ohio, with office at 912 Marshall Bldg., Cleveland, Ohio.

Triplex Screw Co., Cleveland, Ohio, has completed a new building, 180 by 100 feet, adjoining its plant on Grant Ave. The new building is the second unit acquired in the last two years, and houses additional heat-treating facilities, as well as warehouse space.

Norman L. Deuble, formerly assistant to the vice-president of the Copperweld Steel Co., Warren, Ohio, has been appointed manager of sales. Mr. Deuble is a graduate of the Case School of Applied Science, with the degrees of B. S. and Metallurgical Engineer.

Allis-Chalmers Mfg. Co., Milwaukee, Wis., announces that the Toledo, Ohio, district office of the company has been moved from the Second National Bank Bldg. to the Toledo Trust Bldg.

William J. Hawley has been appointed sales engineer of the Kent-Owens Machine Co., Toledo, Ohio, to specialize in the machine tool and milling machine divisions. He was toolroom foreman with the company for eight years, later entering the service department, and more recently the engineering department.

William J. Hawley, New Sales Engineer of the Kent-Owens Machine Co.

R. D. Yoder has been transferred from the Milwaukee headquarters of Cutler-Hammer, Inc., Milwaukee, Wis., manufacturer of electrical control apparatus, to the company's Cincinnati, Ohio, office.

Pennsylvania

William L. Batt, president of S K F Industries, Inc., Philadelphia, Pa., and at present serving the Government in the Production Division, Office of Production Management, has been appointed a member of the Federal Committee on Apprenticeship, succeeding Ralph E. Flanders, president of the Jones & Lamson Machine Co., Springfield, Vt., who has retired from the committee because of the necessity of giving all his attention to the increasing defense production demands placed on his company.

Laurence M. Ewell has been appointed general manager of eastern division operations of the Link-Belt Co., with headquarters at Philadelphia. Mr. Ewell was previously export manager, and manager of the New York office. He will be succeeded by his former assistant, Carl A. Woerwag, who will have headquarters in New York.

Calco Machinery Co., 1420 Chestnut St., Philadelphia, Pa., has been appointed exclusive agent in that territory for the milling machines built by the Kent-Owens Machine Co., Toledo, Ohio.

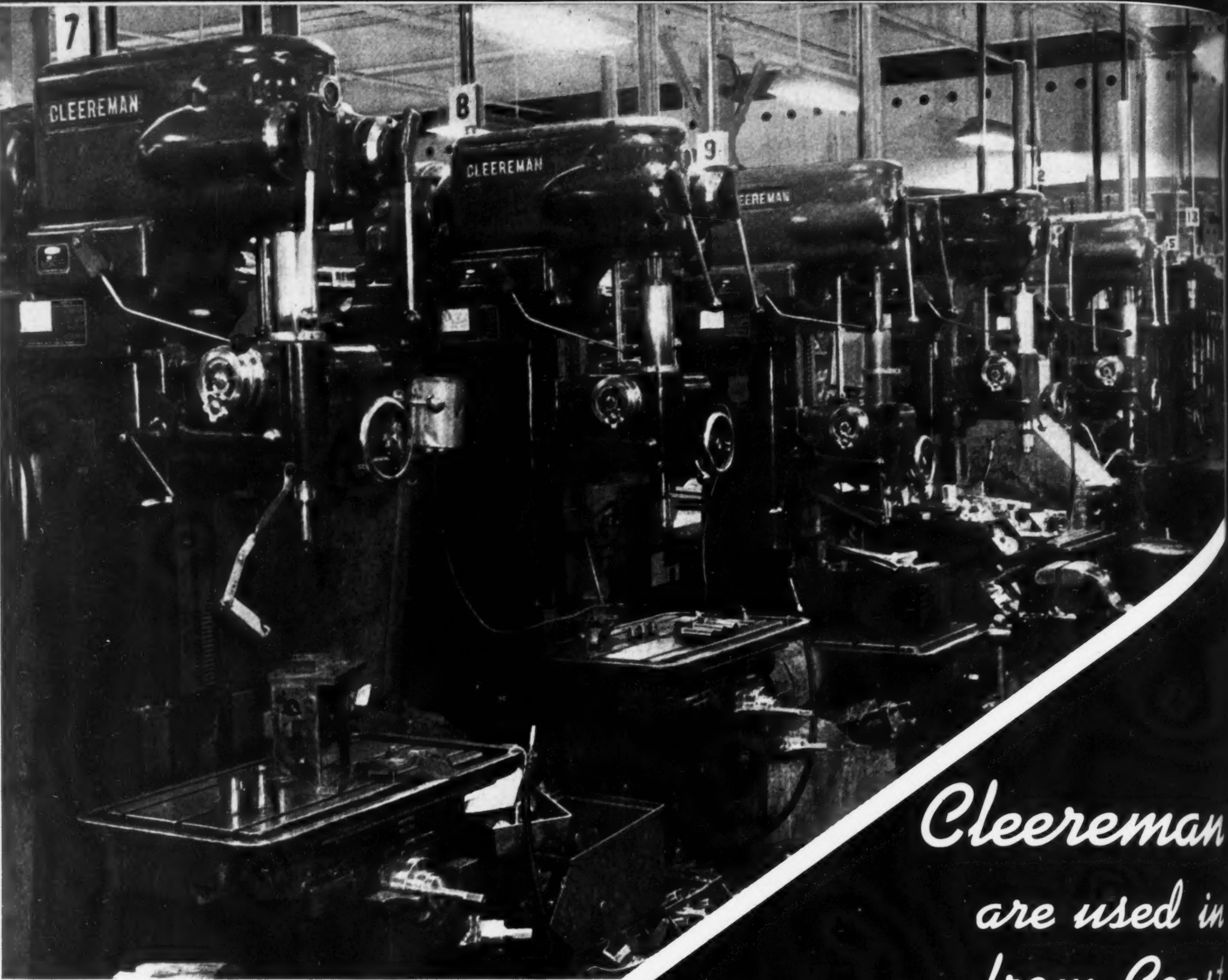
H. E. Doughty has been appointed manager of the recently established Philadelphia branch of the Jessop Steel Co., Washington, Pa., with offices at 225 S. 15th St., Philadelphia, Pa.

Melvin C. Harris has been appointed district manager of the Allegheny Ludlum Steel Corporation, Pittsburgh, Pa., for the purpose of more closely correlating the production facilities of the corporation's two plants in the Pittsburgh district at Brackenridge and West Leechburg. Mr. Harris has been with the corporation twenty-six years, starting in 1915 as a clerk in the company's plate mill. Carl B. Pollock has been appointed manager of the Brackenridge plant. Mr. Pollock has been with the organization since 1932. George W. Evans has been made general superintendent of the Brackenridge plant. He has been with the corporation since 1909.

Melvin C. Harris, District Manager, Pittsburgh, Pa., of the Allegheny Ludlum Steel Corporation

Carl B. Pollock, Manager of the Brackenridge, Pa., Plant of the Allegheny Ludlum Steel Corporation

George W. Evans, General Superintendent of the Brackenridge Plant of the Allegheny Ludlum Steel Corporation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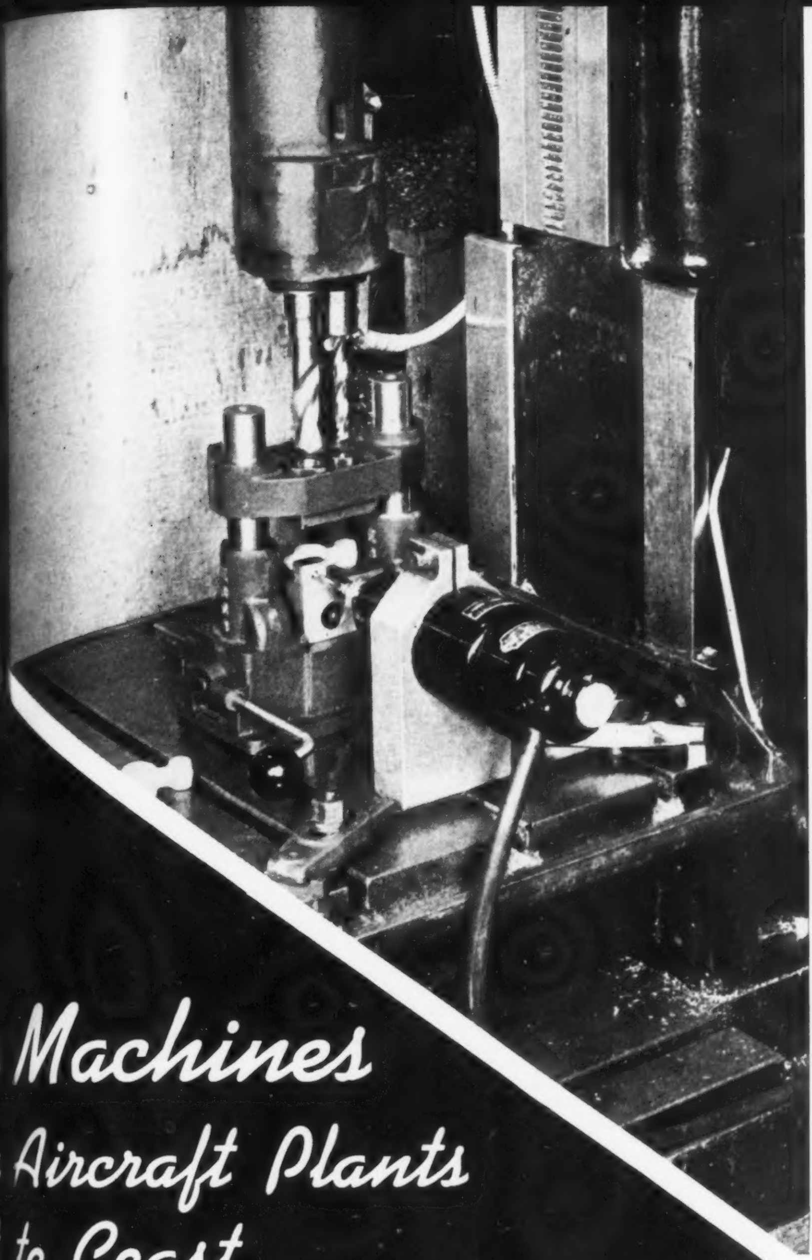
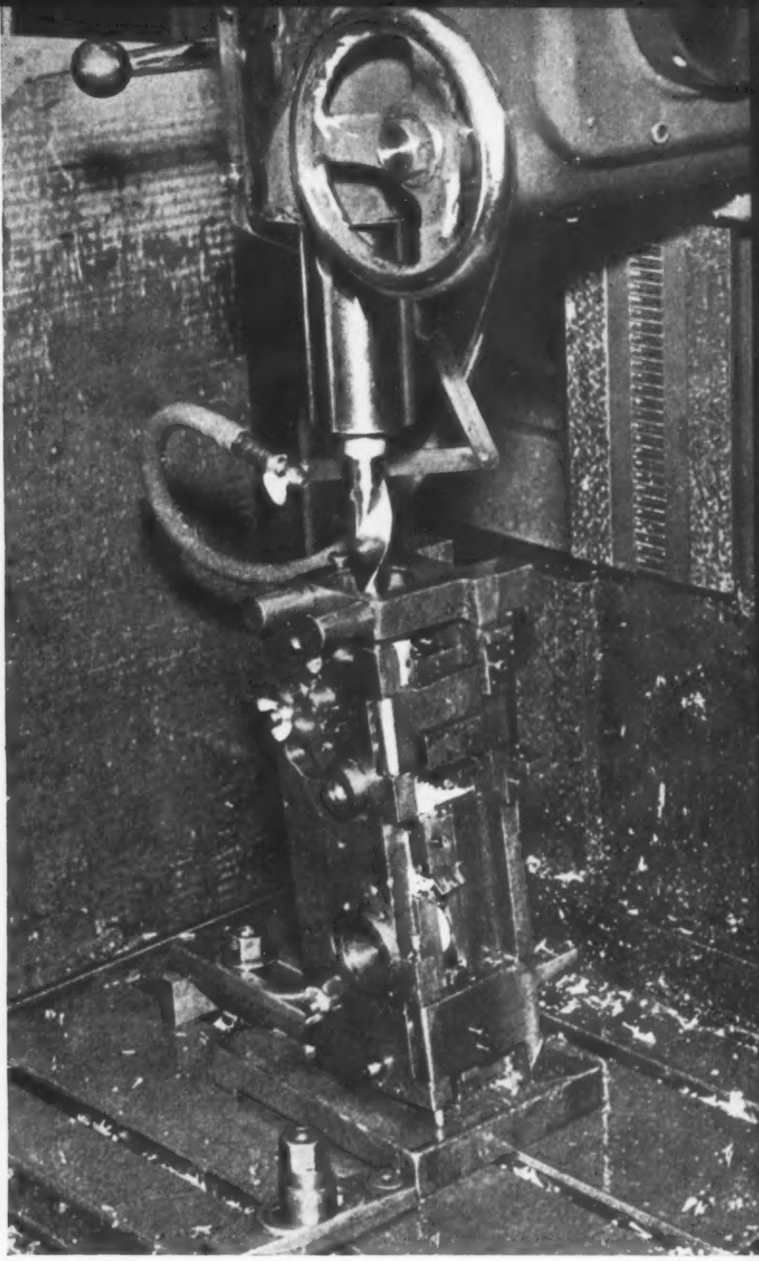




...n Machines
...in Aircraft Plants
...st to Coast

The close-up, above left, illustrates a CLEEREMAN Machine equipped with a special head on the spindle to carry two drills. Note also the Govro-Nelson automatic drilling unit. With this set-up, two holes are simultaneously drilled vertically, while a third is drilled horizontally.

Each airplane is equipped with thirty-eight parts produced by this set-up. Above right, another CLEEREMAN operation in the North American Plant calling for the accurate drilling of seven holes of various sizes in Dural castings for forward control stick sockets.

...REMAN

DRILLING MACHINES and JIG BORERS

A. F. Dohn, Who has Retired from Active Work with the Allegheny Ludlum Steel Corporation

A. F. Dohn, formerly vice-president in charge of tool steel sales of the Allegheny Ludlum Steel Corporation, Pittsburgh, Pa., has retired from active business. He will, however, continue to serve the concern in a consulting capacity and as a vice-president. Mr. Dohn's tool steel experience covers the last thirty years.

W. E. Griffiths and W. F. Detwiler, Jr., have been made manager and assistant manager, respectively, of a new development engineering department organized by the Allegheny Ludlum Steel Corporation, Pittsburgh, Pa. Mr. Griffiths started eighteen years ago as a metallurgist with the Union Carbide and Carbon Research Laboratories, and later held responsible positions with the Duraloy Co., the Central Alloy Division of the Republic Steel Corporation, and the Carnegie-Illinois Steel Corporation. Mr. Detwiler has been with the Allegheny Ludlum organization since 1936.

W. E. Griffiths, Manager of Development Engineering Department, Allegheny Ludlum Steel Corpn.

G. Dewey Spies has been added to the technical sales force of the Quaker Chemical Products Corporation, Conshohocken, Pa. Mr. Spies, who is a trained metallurgist formerly associated with the Republic Steel Corporation, Timken Roller Bearing Co., and the U. S. Steel Corporation, will be located in the northern Ohio territory, with headquarters at 320 Beech St., Berea, Ohio. W. M. Paquin, formerly with the Norge Division of the Borg-Warner Corporation, has been added to the technical sales force in the Wisconsin territory, with headquarters at 2239 N. 59th St., Milwaukee, Wis.

Stanley A. McCaskey has been elected assistant secretary of the Allegheny Ludlum Steel Corporation, Pittsburgh, Pa. Mr. McCaskey was born in Wilkinsburg, Pa., and graduated from Bucknell College in 1927 and from the Harvard Law School in 1931.

Samuel W. Moore, formerly assistant master mechanic of the Jessop Steel Co., Washington, Pa., has been appointed construction engineer in charge of plant rehabilitation and new construction. Mr. Moore has been with the Jessop Steel Co., for fourteen years.

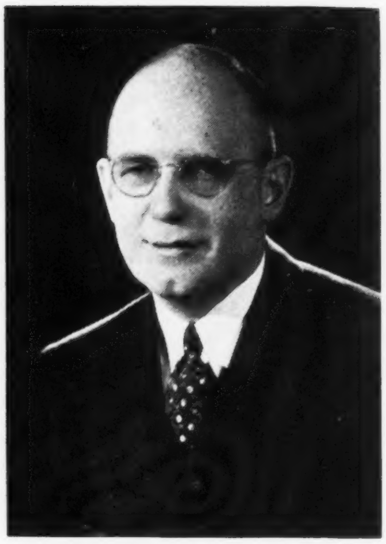
C. A. Powel has been appointed manager of the headquarters engineering departments of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

H. W. Tenny has been appointed assistant director of research of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Wisconsin

W. L. Schneider has been appointed vice-president of sales of the Falk Corporation, Milwaukee, Wis. Mr. Schneider graduated from Marquette University in 1925, and has been with the Falk organization ever since. T. F. Scannell has been appointed sales manager. He is a graduate of Yale University, class of 1918, and became connected with the Falk Corporation in 1928. J. B. Kelley has been made assistant sales manager. He graduated from Marquette University in 1927, and has been with the organization since that time.

M. R. Crossman has been appointed director of the industrial advertising division of the Cramer-Krasselt Co., Milwaukee, Wis. He has had wide experience as a skilled machinist, machine designer, sales engineer, and advertising manager. Mr. Crossman was formerly with the Ingersoll Milling Machine Co., the Illinois Water Treatment Co., Trane Co., Gisholt Machine Co., and the Barber-Colman Co.



Lee H. Hill, Newly Elected Vice-president of the Allis-Chalmers Mfg. Co.

Lee H. Hill was elected vice-president of the Allis-Chalmers Mfg. Co., Milwaukee, Wis., at the last annual meeting of the board of directors. Mr. Hill will be in charge of a newly created industrial relations department instituted to promote cordial relationship between the employes and the management. He was formerly assistant manager of the electrical department.

* * *

Research Engineer Elected to National Academy of Sciences

Dr. Joseph Slepian, associate director of the Westinghouse Research Laboratories, East Pittsburgh, Pa., has been elected a member of the National Academy of Sciences, the oldest scientific advisory body of the Government. Twenty-six years ago, Dr. Slepian exchanged a college teaching career for a factory job. At that time, though he had a thorough education in mathematics, he had never studied engineering. He resigned from the faculty of Cornell University to become a coil-winder in the East Pittsburgh works of the Westinghouse Electric & Mfg. Co.

He obtained his electrical engineering education through self-instruction, and is now recognized as one of the world's outstanding electrical engineers. He has more than 200 patents to his credit. His research work has opened many new pathways in the electrical field. He has helped make possible the distribution of electric power at very high voltages, and has developed a modern lightning arrester for power lines. With L. R. Ludwig, another Westinghouse engineer, he invented the ignitron, a device that changes alternating current to direct current.

OBITUARIES

Dudley Brewster Bullard

Dudley Brewster Bullard, vice-president in charge of engineering of the Bullard Co., Bridgeport, Conn., died June 10 after a long illness at the age of nearly seventy-two years. Mr. Bullard was the oldest of five brothers who carried on the business which was founded by their father, Edward Payson Bullard, Sr.

Mr. Bullard was born in Bristol, Conn., July 13, 1869. He graduated from the Williston Academy in 1891. His practical experience and early engineering education were obtained as an apprentice in the plant of his father, then known as the Bridgeport Machine Tool Works, which later became the Bullard Machine Tool Co., and in 1929, the Bullard Co.

After having served for several years as a machine shop apprentice, he was advanced to the drafting-room, and subsequently became superintendent of the plant. Later he found a wide scope for his experience and ability as chief engineer, and finally was made vice-president in charge of engineering.

As early as 1899, he became a member of the American Society of Mechanical Engineers, and took an active part in the work of the Bridgeport Section of the Society, serving as its chairman in 1931-1932. He was a member of the Standing Committee on Research of the Society for five years. Mr. Bullard was also a member of the Bridgeport Engineers Club, of which he was president in 1930. He also served as president of the Southport National Bank, and for many years, until the time of his death, was a director of the Black Rock Bank & Trust Co., of Bridgeport, Conn. He was a member of the Common Council of the City of Bridgeport, 1910-1912, and was also active in various civic organizations, including the Bridgeport Christian Union, the Young Men's Christian Association, and the Boy Scouts.

Mr. Bullard is survived by his wife, Alice Clark Bullard; his daughter, Dorothy B. Bullard of Hartford, Conn.; and his two sons, Edward C. Bullard, vice-president and general manager of the Bullard Co., and Raymond C. Bullard, advertising manager of the company. He is also survived by two granddaughters and two grandsons.

Cornelius King Chapin

Cornelius King Chapin, president of the Murchey Machine & Tool Co., Detroit, Mich., died suddenly in Cleveland, Ohio, on May 6. Mr. Chapin was born in Lansing, Mich., April 28, 1877, and attended the Michigan State University at Lansing and the University of Michigan at Ann Arbor. After graduation, he founded the Eclipse Lightning Rod Co., of which he was president until October, 1912, when he and his brother-in-law, W. H. Jennings, purchased the Murchey Machine & Tool Co., which organization they incorporated. Mr. Chapin was president of the company from that time until his death. He was also a director of the Hudson Motor Car Co., the Michigan Bakeries, Inc., and the Industrial National Bank.

Cornelius K. Chapin

Edward T. Buckwell, formerly secretary and manager of sales of the Cleveland Twist Drill Co., Cleveland, Ohio, died in that city May 28 at the age of eighty-three years. He was an active director of the company at the time of his death.

In the early nineties, Mr. Buckwell was a salesman for Sargent & Co., covering the south Atlantic states; later he engaged in the retail hardware business in Knoxville, Tenn., as a partner in the firm of McClung, Buffet & Buckwell. He became connected with the Cleveland Twist Drill Co. in 1899, and served as manager of sales until his retirement in 1922. During this period he built up an efficient sales force and was responsible for establishing many of the most important distributors of the company's products throughout the country.

COMING EVENTS

July 23-26—Twenty-fourth Industrial Conference to be held at Silver Bay, on Lake George, N. Y. E. H. T. Foster, executive secretary, 347 Madison Ave., New York City.

September 17-19 — Annual conference of the National Industrial Advertisers Association at the Royal York Hotel, Toronto, Canada. For additional information, address National Industrial Advertisers Association, Inc., 100 E. Ohio St., Chicago, Ill.

October 6-11 — Exposition of Power and Mechanical Engineering at the International Amphitheatre, Chicago, Ill. For further information, address Charles F. Roth, manager, Grand Central Palace, New York City.

October 12-15—Fall meeting of the American Society of Mechanical Engineers at Louisville, Ky. C. E. Davies, secretary, 29 W. 39th St., New York City.

October 16-18 — Semi-annual meeting of the American Society of Tool Engineers at the Royal York Hotel, Toronto, Canada. Ford R. Lamb, executive secretary, 2567 W. Grand Blvd., Detroit, Mich.

October 20-24—Twenty-third National Metal Congress and Exposition to be held in Convention Hall and Commercial Museum, Philadelphia, Pa. Further information can be obtained from W. H. Eisenman, secretary, American Society for Metals, 7301 Euclid Ave., Cleveland, Ohio.

October 30-November 1—National Aircraft Production Meeting of the Society of Automotive Engineers at the Biltmore Hotel, Los Angeles, Calif. John A. C. Warner, secretary and general manager, 29 W. 39th St., New York City.

December 1-5—Annual meeting of the American Society of Mechanical Engineers at the Hotel Astor, New York City. C. E. Davies, secretary, 29 W. 39th St., New York City.

Cutting aluminum alloy windshield frames at the Douglas plant. Quickwork construction enables the operator to follow irregular outlines with ease.

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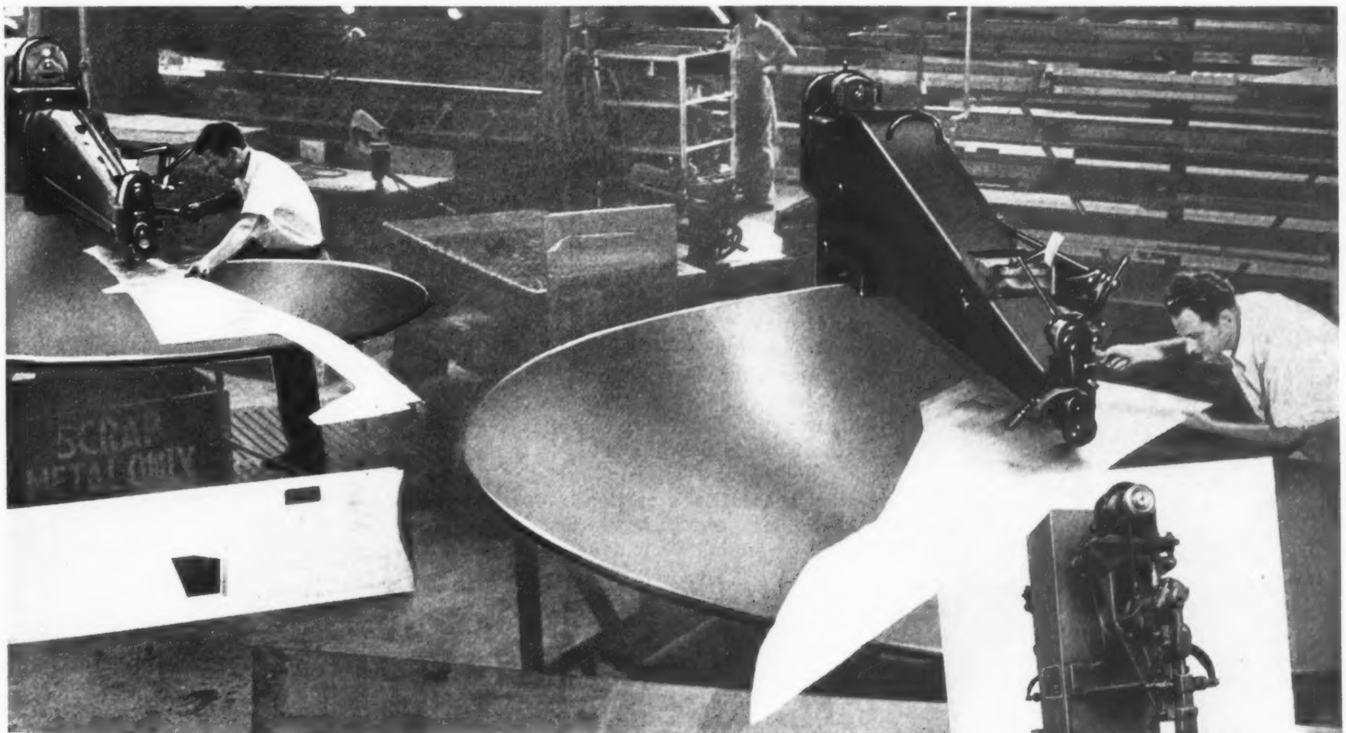
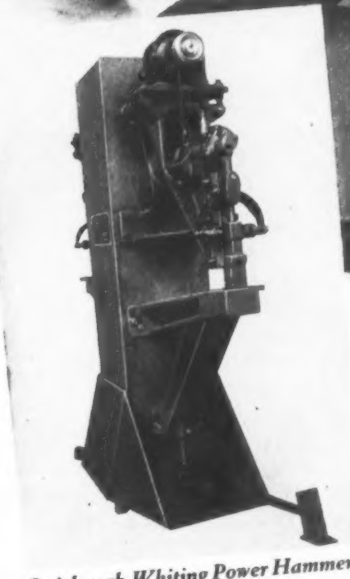


Quickwork Deep Throated Rotary Shears in the Douglas Aircraft Plant, Santa Monica, California. Men are cutting irregular-shaped aluminum alloy wing sections.



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NEW BOOKS AND PUBLICATIONS

MODERN METALLURGY FOR ENGINEERS. By Frank T. Sisco. 426 pages, 6 by 9 inches; 125 illustrations and diagrams; 37 tables. Published by the Pitman Publishing Corporation, New York City. Price, $4.50.

The author of this book, who was formerly chief of the metallurgical laboratory of the United States Army Air Corps, Wright Field, had three objectives in mind in writing this book. The first was to give the undergraduate and graduate student in engineering a broad but concise outline of the art and science of metallurgy; the second and equally important objective was to summarize the present status of metallurgy for older engineers who, in the years they have been practicing their profession, may have lost touch with advances in metallurgical developments; and the third was to survey the whole field of ferrous and non-ferrous metallurgy with especial attention to structure and properties for the benefit of those in the metal industries who either have not had the advantage of a broad fundamental training or who have been working in such narrow fields that they have lost touch with developments in fields other than their own.

Probably the scope and contents of this book can be best conveyed by listing the chapter headings: Metallurgy and Engineering; Fundamental Structure of Metals and Alloys; Manufacture of Iron and Steel; Composition of Carbon and Alloy Steels; Constitution of Steel; Fundamentals of Heat-Treatment of Steel; Operations of Heat-Treatment; Significance of the Static Properties of Metallic Materials; Significance of the Dynamic Properties of Metallic Materials; Machinability, Wear Resistance, and Deep-Drawing Properties; Carbon Steel as an Engineering Material; Gray Cast Iron and Malleable Cast Iron; Low-Alloy Steels as Engineering Materials; High-Alloy Steels as Engineering Materials; Tool and Die Steels; Precipitation Hardening and the Constitution of Non-Ferrous Alloys; Light Alloys as Engineering Materials; Copper and Copper-Base Alloys as Engineering Materials; Miscellaneous Heavy Non-Ferrous Alloys; Corrosion and Corrosion Resistance; Effect of Temperature on the Mechanical Properties of Ferrous and Non-Ferrous Alloys.

LESSONS IN ARC WELDING. 176 pages, 6 by 9 inches; 170 illustrations. Published by the Lincoln Electric Co., Cleveland, Ohio. Price, 50 cents postpaid in the United States; 75 cents elsewhere.

This is the second edition of a book that makes available to industry and to engineering, trade, and vocational schools the accumulated welding instruction information of the Lincoln Welding School, which has been in continuous operation for twenty-four years. It is considered a standard textbook on welding, and is used by many educational institutions that include courses in arc welding as a regular part of their instruction. The book is also a ready reference volume on arc welding, and a guide to its proper application; as such, it will be found useful by supervisors, foremen, and instructors, as well as by experienced welders.

The book contains a series of sixty lessons presenting, in a concise manner, the fundamental facts of welding, knowledge of which will enable the welder to utilize the process successfully and economically. It follows a definite plan for teaching these fundamental principles and gives also a great amount of information useful to those interested in arc welding.

A B C OF AVIATION. By Victor W. Page. 598 pages, 5 by 7 1/2 inches; 285 illustrations. Published by Norman W. Henley Publishing Co., 17 W. 45th St., New York City. Price, $2.50.

This book, characterized as a simplified guide to modern aircraft, covers practically all types of aircraft giving information on the basic principles of construction and operation. It describes important recent airplanes, Diesel and gasoline airplane engines, air liners, plastic planes, inspection procedure, and trouble-shooting prior to flights, instruments used for blind flight, and radio aids and beacons. This is the second revised and greatly enlarged edition of the author's earlier book on the same subject, containing information on the latest engine developments.

BLUEPRINT READING FOR THE MACHINE TRADES. By John J. Weir. 82 pages, 8 3/4 by 11 inches. Published by the McGraw-Hill Book Co., 330 W. 42nd St., New York City. Price, $1.25.

This book does not attempt to cover the entire field of blueprint reading. Its aim is rather to give the basic material needed for a short course in blueprint reading for the machine trades. The material has been divided into fifteen lessons, each of a length suitable for presentation during a class period. Questions and practice work in the form of sketching problems and blueprints to be read are provided with each lesson. The book is published in loose-leaf form so that instructors can insert additional material if desired.

MACHINE TRADES BLUEPRINT READING. By Russel W. Ihne and Walter E. Streeter. 140 pages, 9 by 11 inches. Published by the American Technical Society, Drexel Ave. at 58th St., Chicago, Ill. Price, $2.

This book, which is published in loose-leaf form, printed by the offset process, is designed to provide all the basic information necessary to interpret a blueprint. Actual blueprints are reproduced, starting with simple prints that illustrate fundamental principles, and proceeding gradually to complete production blueprints, taken from industry. A question sheet accompanies each print, with a space for writing in the answers.

A GOOD MECHANIC SELDOM GETS HURT. By Herman R. Graman. 94 pages, 4 3/4 by 7 inches. Published by the American Technical Society, Drexel Ave. at 58th St., Chicago, Ill.

The author of this book is machine shop instructor and assistant supervisor of National Defense Training at the Parker Vocational High School, Dayton, Ohio. The book refers specifically to machine shop work and is particularly intended for young men starting to work in machine shops. It is made up chiefly of rules and dont's pertaining to machine tool operation, the rules being classified under types of machines and operations.

HEALTH HAZARDS OF OCCUPATIONAL ENVIRONMENTS. 45 pages, 6 by 9 inches. Published by the Department of Public Health of the state of Illinois, Springfield, Ill., as Educational Health Circular No. 154.

John H. Flagg, President of the Watson-Flagg Machine Co., Inc., Paterson, N. J., who has been Elected Vice-president of the American Gear Manufacturers Association